



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Fisheries Science Center
Fish Ecology Division
2725 Montlake Boulevard East
Seattle, Washington 98112-2097

April 19, 2005

MEMORANDUM FOR: F/PR - Laurie Allen

FROM: F/NWC3 - John W. Ferguson *John W. Ferguson*

SUBJECT: Revised Estimation of Percentages for
Listed Pacific Salmon and Steelhead
Smolts Arriving at Various Locations in
the Columbia River Basin in 2005

This Memorandum revises and supersedes an earlier "Estimation" Memorandum I sent you dated March 31, 2005. The original Memorandum has been revised to include updated information on subyearling fall Chinook salmon from the Snake River we recently received.

Each year your office requests a description of how the Fish Ecology Division calculates the percentages of listed wild and hatchery fish at selected Columbia and Snake River projects. These estimates are necessary for evaluating the potential impacts of proposed research on listed species. Given new hatchery release estimates, we have computed percentages for 2005. The attached tables show our best estimates for the total numbers of protected juvenile Pacific salmon and steelhead arriving at Columbia River and Snake River dams during the 2005 outmigration, and the percentage of the total collection they will comprise at each dam. We have developed estimates based on a Aspread the risk@ scenario (transportation with spill; assuming river conditions that have existed in the past) and on a full transportation scenario (with no spill). Tables 1-6 show the development of the estimates, Tables 7-10 summarize the estimates for each listed species at each project, and Table 11 presents our estimates of the total run size for each listed group of fish.



We are providing this information so that Protected Resources Division (F/PR3) staff can better understand how these percentages were derived. Although the following descriptions may seem intimidating, it was necessary to provide this level of detail to describe anticipated conditions for 2005.

Several Snake River species will have unmarked hatchery fish released for the 2005 outmigration. Approximately 400,000 hatchery spring/summer Chinook salmon will be released with only a coded-wire tag (CWT) (no external mark). All 400,000 will be from listed stocks. Because we have encountered unmarked hatchery spring/summer Chinook salmon in the past, we have adopted a practice of labeling any unclipped spring/summer Chinook salmon that is greater than 124-mm in fork length as hatchery-origin fish. To derive this fork length, we analyzed data from wild spring/summer Chinook salmon PIT-tagged in their natal streams (by our wild parr marking project; Permit #1406, Study 1) that were subsequently captured and re-measured at one of the lower Snake River dams during slide-gate evaluations (1989-1994 and 1999-2003).

In 2005, approximately 293,500 hatchery steelhead will also be released with only a CWT (no external mark), while another 843,000 hatchery steelhead will have no marks or tags. Juvenile hatchery steelhead are usually identifiable by their degraded fins, particularly the dorsal and pectoral fins.

Approximately 4,150,000 unlisted Lyons Ferry Hatchery subyearling fall Chinook salmon may be released above Lower Granite Dam. Of these fish, 2,150,000 will be unmarked, making them indistinguishable from wild subyearling fish. The effects of these fish are covered in the section on subyearling fall Chinook salmon.

All researchers should be aware that 300,000 yearling fall Chinook salmon will be released above Lower Granite Dam in 2005, and that 450,000 yearling fall Chinook salmon will be released directly from Lyons Ferry Hatchery. All of the Lyons Ferry Hatchery yearling releases will be marked with visual eye tags. Since these hatchery fish are not currently listed, all researchers should be certain that they identify these fish as fall Chinook salmon, not as listed yearling spring/summer Chinook salmon.

For several groups of fish, we could find no new information; therefore, our estimates for these groups are the same as last year.

Feel free to discuss this memorandum with all interested parties.

Attachments

cc: F/NWC1 - Ford
F/NWC2 - Dickhoff
F/NWC3 - Casillas
F/NWC3 - Dey
F/NWC3 - Ferguson
F/NWC3 - Gores
F/NWC3 - Ruehle
F/NWC3 - Williams
F/NWC3 - Williams
F/NWC4 - Clarke
F/NWC5 - Collier
F/NWR3 - Griffin
F/NWR3 - Schaeffer
F/NWR5 - Ruff
F/PR3 - Jackson

SPRING/SUMMER CHINOOK SALMON ESTIMATES

Snake River ESU

Our estimate of wild fish arriving at Lower Granite Dam is based on Idaho Department of Fish and Game and Oregon Department of Fish and Wildlife redd counts for brood year 2003. Redd counts were grouped by drainages for which we had fecundity rates (Middle Fork of the Salmon River, South Fork of the Salmon River, Salmon River (excluding Middle and South Forks), Clearwater River, Imnaha River, and Grande Ronde River). We set the egg-to-smolt survival rate (to Lower Granite Dam) at 10%. We estimate that 2,813,811 wild/natural spring/summer Chinook salmon will reach Lower Granite Dam in 2005. We estimate that 10,727,394 hatchery smolts will be released from Idaho (9,703,494) and Oregon (1,023,900).

In order to estimate how many hatchery smolts will reach Lower Granite Dam, we first estimated the percentage composition of Snake River spring/summer Chinook salmon arriving at the dam from listed hatcheries (Table 1). Using the mean survival estimates for the 1993-2004 outmigrations (excluding 2001, which was a record low flow year), we estimated the total number of hatchery fish that will arrive at Lower Granite Dam. We applied the mean survival estimate for each hatchery from these 12 years to the 2005 projected release numbers for each hatchery. We estimate that 6,776,956 or 63.17430% of the 10,727,394 hatchery fish released will arrive at Lower Granite Dam.

The percentage composition of listed hatchery spring/summer Chinook salmon arriving at Lower Granite Dam in 2005 will be 11.19575% (Table 1). Using this percentage, we estimated the number of listed hatchery fish arriving at Lower Granite Dam.

$$\left(\begin{array}{c} \text{listed hatchery} \\ \text{fish to Granite} \end{array} \right) = \left(\begin{array}{c} \text{total hatchery fish} \\ \text{arriving at Granite} \end{array} \right) \times \left(\begin{array}{c} \% \text{ of listed} \\ \text{hatchery fish} \\ \text{that are listed} \end{array} \right) =$$

$$758,731 = 6,776,956 \times 0.1119575$$

Knowing the total number of hatchery fish, the number of listed hatchery fish, and the number of wild fish arriving at Lower Granite Dam, we estimated the percentage composition of listed hatchery fish and wild fish arriving at the dam.

$$\begin{aligned} \text{total smolts} &= \text{total hatchery fish} + \text{wild fish} = \\ 9,590,767 &= 6,776,956 + 2,813,811 \end{aligned}$$

$$\begin{aligned} \% \text{ wild fish to dam} &= \text{wild fish} / \text{total smolts} = \\ 29.3387\% &= 2,813,811 / 9,590,767 \end{aligned}$$

$$\% \text{ listed hatchery fish} = \text{listed hatchery fish} / \text{total smolts} = 7.91103\% = 758,731 / 9,590,767$$

We set fish guidance efficiencies (FGE) at Lower Granite and Little Goose Dams to 0.418 and 0.458, respectively. Using an FGE of 0.418, the total collection at Lower Granite Dam will be 4,008,941 ($9,590,767 \times 0.418$), based on 9,590,767 smolts arriving at the dam. Wild, listed hatchery, and non-listed hatchery fish, will comprise 1,176,171, 317,149, and 2,515,621 of the total collection, respectively.

Tucannon River fish, both hatchery and wild, are within the Snake River spring/summer Chinook salmon Evolutionarily Significant Unit (ESU) and are considered listed fish. In spring 2005, 30,000 wild fish and 190,000 hatchery fish are expected to outmigrate from the Tucannon River. The Tucannon River joins the Snake River between Little Goose and Lower Monumental Dams. Because of the short distance from the confluence to Lower Monumental Dam, we assumed no mortality of these fish prior to Lower Monumental Dam. The estimates shown in Table 2 and Tables 7-8 reflect the addition of these fish above Lower Monumental Dam.

Since 1995, some of the PIT-tagged fish bypassed at the collection dams (Lower Granite, Little Goose, Lower Monumental, and McNary Dams) have been returned to the river to continue migrating inriver. This return of fish to the river requires adjustment of our estimates of the number of listed fish that reach McNary Dam. We estimated the number of fish that will be PIT-tagged for 2005 and, as described in Appendix A, adjusted for fish diverted to transportation at each Snake River collector dam. If transportation occurs at McNary Dam, we also assumed that 100% of all PIT-tagged fish would be returned to the river. A detailed description of how we estimated the impact of returning PIT-tagged fish to the river is presented in Appendix A. We estimated that 62,962 PIT-tagged spring/summer Chinook salmon from the Snake River (including 13,706 wild and 12,224 listed hatchery fish) will be collected at McNary Dam because they were returned to the river at an upstream dam(s). These numbers represent collected fish. Dividing the collected number by the FGE at McNary Dam (0.384), we determined that 35,693 wild ($13,706 / 0.384$) and 31,833 listed hatchery ($12,224 / 0.384$) fish will arrive at McNary Dam and must be added to the number of fish that were estimated to reach McNary Dam as a result of not having been collected at an upstream dam (column "Listed fish to McNary", Table 2).

Upper Columbia River ESU

The Upper Columbia River ESU spring Chinook salmon is listed as endangered under the ESA. The ESU begins at the confluence of the Yakima and Columbia Rivers and continues upstream to Chief Joseph Dam.

Adults that returned in 2003 produced the smolts that will outmigrate in 2005. We obtained 2003 redd counts for the major Columbia River tributaries in this ESU from Washington Department of Fish and Wildlife (WDFW) and the Yakama Indian Nation. Fecundity estimates for this ESU range from 4,000 to 5,500 eggs per female. Estimates for egg-to-smolt survival generally range up to 19%. Using the median egg count, 4,750, and a conservative egg-to-smolt survival estimate (to the first dam encountered) of 15%, we estimated the number of smolts that each stream will produce.

We also have hatchery release estimates for this ESU from WDFW and the U.S. Fish and Wildlife Service. There are no survival estimates for these hatcheries. So, based on the distance from the hatchery to the first dam the fish will encounter, we assigned the same survival estimates for Snake River hatcheries, with similar distances to the first dam. Using this method, we assigned a survival rate of 0.778 (Dworshak Hatchery's survival estimate to Lower Granite Dam) to the fish from Winthrop, Methow, Entiat, and Leavenworth Hatcheries, a survival estimate of 0.645 (Rapid River Hatchery's estimate to Lower Granite Dam) to Cle Elum Hatchery, and a survival estimate of 100% to Eastbank and Ringold Hatcheries.

Because we have no per-project survival information for spring Chinook salmon in the Columbia River above McNary Dam, we assigned the same per-project estimate (0.9) used on the Snake and lower Columbia Rivers. Survival estimates derived from a 1 year study using yearling hatchery fall Chinook salmon support using this estimate (M. Brad Eppard, NMFS, Pers. commun., January 1999).

Based on the assumptions stated above, we derived the estimates shown in Table 7. Based on projected hatchery releases and the number of wild smolts we estimate will outmigrate from the various drainages along the Columbia River above McNary Dam, we estimate that 4,203,527 spring Chinook salmon will arrive at McNary Dam. Listed wild, non-listed wild, listed hatchery, and non-listed hatchery fish, will comprise 530,498, 1,300,313, 514,040, and 1,858,676 of the total number, respectively. Note that the numbers shown for Columbia River dams above McNary Dam are numbers arriving at the dam and not the numbers collected at the dam. The reason for this is that fish guidance efficiency (FGE) for these dams is either unknown or is currently being evaluated.

Estimate of Fish Arriving at McNary Dam

McNary Dam is the first dam on the Columbia River below the confluence of the Snake River. To obtain an estimate of the number of spring/summer smolts arriving at McNary Dam, we added the estimated numbers from the Columbia River above McNary Dam (4,203,527) and the Snake River (1,561,350).

We estimate that 5,764,877 (4,203,527 + 1,561,350) spring/summer Chinook salmon smolts will arrive at McNary Dam in 2005, and that 2,213,713 fish will be collected (FGE = 0.384). Of the 2,213,713 smolts collected at McNary Dam, 367,906 (16.6%) will be wild (203,711 Upper Columbia River ESU and 164,195 Snake River ESU), 499,320 (22.6%) will be non-listed wild (all non-listed wild fish are from the Columbia River below the Upper Columbia River ESU), 286,745 (13%) will be listed hatchery (197,391 Upper Columbia River ESU and 89,354 Snake River ESU), and 1,059,741 (47.9%) will be non-listed hatchery fish (713,732 Columbia River and 346,009 Snake River). The ratio of Upper Columbia River ESU wild fish to Snake River ESU wild fish at McNary, John Day, and The Dalles Dams will be 55.4%:44.6% (264,697:213,351). The ratio of Upper Columbia River ESU listed hatchery fish to Snake River ESU listed hatchery fish at McNary, John Day, The Dalles, and Bonneville Dams will be 68.8%:31.2% (230,837:104,495).

We received some redd information from Oregon Department of Fish and Wildlife (ODFW) for the John Day River and, using the same redd to smolt calculation as described above, we added 815,100 wild unlisted fish between McNary and John Day Dams. We did not receive any 2003 redd count data for the Deschutes River, so we estimated the number of redds by multiplying the 2001 redd count by the change between the 2001 and 2003 redd counts from the John Day River. This resulted in 490,200 wild unlisted fish being added between John Day and The Dalles Dams. However, because none of these fish are listed, there will be no effect on the ratios of Upper Columbia River ESU and Snake River ESU listed fish.

Lower Columbia River ESU

The Lower Columbia River ESU extends from the mouth of the Columbia River to the crest of the Cascade Range, excluding populations above Willamette Falls. This ESU includes wild spring-run and fall-run Chinook salmon. No hatchery fish in this ESU are listed. The fall-run fish will be discussed below under the subyearling fall Chinook salmon section. We have no information on spawning above Bonneville Dam for this ESU. This ESU will introduce 1,152,358 spring Chinook salmon below Bonneville Dam.

Estimate of Fish Arriving at Bonneville Dam

At Bonneville Dam, the ratio of Upper Columbia River ESU and Snake River ESU listed wild fish (there is no information on Lower Columbia River ESU spawning above Bonneville Dam) will be 55.4%:44.6% (238,227:192,016)

Fish transported from Snake River dams and McNary Dam are released below Bonneville Dam. The number of listed transport fish returned to the river will be 2,995,014 (2,274,412 wild and 720,602 listed hatchery) and 385,098 (196,122 wild and 188,976 listed hatchery) for the Snake River and Upper Columbia River

ESUs, respectively. A total of 9,405,890 transported spring/summer Chinook salmon will be released below Bonneville Dam.

Upper Willamette River ESU

The Upper Willamette River ESU contains spring Chinook salmon populations above Willamette Falls. No hatchery fish in this ESU are listed. This ESU will introduce 8,166,126 listed wild spring Chinook salmon to the Columbia River below Bonneville Dam.

The ratio of Upper Columbia River ESU, Snake River ESU, Lower Columbia River ESU, and Upper Willamette River ESU listed wild fish at Tongue Point will be 5.5%:31.2%:14.6%:48.7% (434,349:2,466,428:1,152,358:3,847,700). The ratio of Upper Columbia River ESU listed hatchery fish and Snake River ESU listed hatchery fish at Tongue Point will be 33.7%:66.3% (419,813:825,097).

Per-project survival (0.9) was retained from last year's (2004) estimate (Table 2).

Summary

Tables 7 and 8 present a summary of the estimated number of fish that will be collected, or will be arriving (Columbia River dams above McNary Dam), at each of the dams during 2005. This information is derived from the data shown in Tables 1-2 and Appendix Table A1. Table 11 shows the estimated number of spring and spring/summer Chinook salmon expected to outmigrate from each ESU.

SUBYEARLING FALL CHINOOK SALMON ESTIMATES

To estimate the 2005 collection number at Lower Granite Dam, we used the 2004 collection number and the adult returns over the dam for 2003 and 2004. In 2004, 1,530,000 unmarked hatchery subyearling fall Chinook salmon were released above Lower Granite Dam. Assuming a survival rate of 0.676 (the estimated survival rate of hatchery subyearling fall Chinook salmon released above Lower Granite Dam in 2004), 1,034,790 (1,530,000 x 0.676) of these fish would have arrived at Lower Granite Dam. Assuming an FGE of 0.654 (derived from PIT-tagged hatchery subyearling fall Chinook salmon in 2004), 676,753 (1,034,790 x 0.654) would have been collected at Lower Granite Dam. Through December 31, 2004 960,323 unclipped (and without a coded-wire tag) subyearling Chinook salmon had been collected at Lower Granite Dam. By removing the estimated 676,753 unmarked hatchery subyearling fall Chinook salmon, we estimate that 283,570 (960,323 - 676,753) wild subyearling fall Chinook salmon were collected at Lower Granite Dam in 2004. These wild subyearling fall Chinook salmon were from the 2003 adult return. The adult count over Lower Granite Dam in 2003 was 11,732. Of these, 776 were hatchery fish that were returned to Lyons Ferry Hatchery and 10,956 adults were passed above Lower Granite Dam. The 2005 outmigration will be the result of the 2004 adults passed over Lower Granite Dam. Through December 31, 2004, 14,960 adults had been counted in the adult ladder. Of these, 2,487 fish were returned to Lyons Ferry Hatchery, leaving 12,473 adults that were passed above Lower Granite Dam. The 2004 count of 12,473 adults represents a 113.8% increase over the 2003 count (10,956). We applied this increase (113.8%) to the 2004 subyearling collection number to arrive at the estimated 2005 collection number.

$$\left(\begin{array}{c} \text{total wild fall Chinook} \\ \text{collected at Granite} \end{array} \right) = \left(\begin{array}{c} \text{wild fall Chinook} \\ \text{collected in 2004} \end{array} \right) \times \left(\begin{array}{c} \% \text{ change between adult counts for} \\ \text{2004 and 2005 outmigrations} \end{array} \right) =$$

$$322,703 = 283,570 \times 113.8$$

We estimated the total number of wild subyearling fall Chinook salmon arriving at Lower Granite Dam by dividing the number of wild fish collected by the FGE at Lower Granite Dam. The average estimated FGE for PIT-tagged hatchery subyearling fall Chinook salmon arriving at Lower Granite Dam from 1995-2004 (excluding 2001) is 0.542.

$$\text{total wild fall Chinook} = \text{total wild fall Chinook collected} / \text{FGE} =$$

$$595,393 = 322,703 / 0.542$$

The Nez Perce Tribe will release 4,150,000 unlisted supplementation subyearling fall Chinook salmon in the Clearwater River basin in 2005. Of these fish, 2,150,000 will be unmarked. Assuming a survival rate of 0.404 (the average estimated survival rate of PIT-tagged hatchery subyearling fall Chinook salmon

released above Lower Granite Dam from 1995-2004 (excluding 2001)), 868,600 ($2,150,000 \times 0.404$) of these fish will arrive at Lower Granite Dam. By adding these fish to the total number of wild fall Chinook salmon (595,393), we estimate that 1,463,993 unmarked subyearling fall Chinook salmon will arrive at Lower Granite Dam. The percentage of unmarked subyearling fall Chinook salmon that are wild will be 40.67% ($595,393/1,463,993$). Of the 2,000,000 ($4,150,000 - 2,150,000$) marked hatchery subyearling fall Chinook salmon to be released above Lower Granite Dam, 808,000 ($2,000,000 \times 0.404$) will arrive at Lower Granite Dam. NMFS and the U.S. Fish and Wildlife Service will be conducting research using 179,000 hatchery subyearling fall Chinook salmon. Based on survival to Lower Granite Dam (0.404), 72,316 ($179,000 \times 0.404$) will arrive at Lower Granite Dam. We added the total unmarked fish (1,463,993), the total marked fish (808,000), and the total research fish (72,316) to determine the total number of subyearling fall Chinook salmon arriving at Lower Granite Dam (2,344,309).

Knowing the total number of fish and the number of wild fish, we estimated the number of fish collected at Lower Granite Dam, and the percentage composition of wild fish arriving at Lower Granite Dam.

$$\begin{aligned} \text{fall Chinook collected} &= \text{total fall Chinook} \times \text{FGE} = \\ 1,270,615 &= 2,344,309 \times 0.542 \end{aligned}$$

$$\begin{aligned} \% \text{ wild fish} &= \text{total wild fall Chinook} / \text{total fall Chinook} = \\ 25.4\% &= 595,393 / 2,344,309 \end{aligned}$$

NMFS has conducted subyearling fall Chinook salmon survival tests since 1995. As part of these tests, we estimated actual FGE's for McNary Dam (factoring in effects of spill). To more accurately estimate the collection number at McNary Dam, we averaged these actual FGE's for 1995-2004 (excluding 2001). We also averaged the number of fall Chinook salmon adults crossing McNary Dam for each of the brood years (1994-2003) and the number of juvenile subyearling fall Chinook salmon collected at McNary Dam (1995-2004). The 2004 count of 170,648 adults represents 182.2% of the average for 1994-2003 count (93,646). We applied this change (182.2%) to the average 1995-2003 subyearling collection number (6,754,101) to arrive at an estimated 2005 collection number (12,305,972).

Based on the NMFS subyearling fall Chinook salmon survival studies conducted in 1995-2004 (excluding 2001), per-project survival was set at 75%. We set the FGEs at Little Goose, Lower Monumental, and McNary Dams, based on 1995-2004 (excluding 2001) NMFS fall Chinook salmon survival study results, to 0.513, 0.459, and 0.509, respectively.

Lower Columbia River ESU

The Lower Columbia River wild tule and late-run bright fall Chinook salmon are listed protected species. No hatchery fish are listed in this ESU.

To determine the number of wild outmigrants from this ESU, we assumed that 50% of the adults counted in the spawning areas were female and that every female spawned successfully. We used average fecundity and set the egg-to-smolt survival rate at 15%, the same used for spring/summer Chinook salmon.

Based on this method of estimation, we estimate that 394,528 tule fall Chinook salmon will outmigrate from above Bonneville Dam. No late-run bright fish will enter the Columbia River above Bonneville Dam. Additionally, 8,177,741 tule fall Chinook salmon and 4,009,111 late-run bright fall Chinook salmon should enter the Columbia River below Bonneville Dam.

The ratio of Snake River ESU and Lower Columbia River ESU (tule fall Chinook salmon) listed wild fish at Bonneville Dam will be 1.7%:98.4% (6,629:394,528).

Fish transported from Snake River dams and McNary Dam are released below Bonneville Dam. The number of listed transport fish returned to the river will be 491,965, all from the Snake River ESU. A total of 14,230,263 transported subyearling fall Chinook salmon will be released below Bonneville Dam.

The ratio of Snake River ESU, Lower Columbia River ESU (tule fall Chinook salmon), and Lower Columbia River ESU (late-run bright fall Chinook salmon) listed wild fish at Tongue Point will be 3.8%:65.5%:30.7% (498,594:8,572,269:4,009,111).

Summary

Table 7 presents a summary of the estimated number of fish that will be collected, or will be arriving (Columbia River dams above McNary Dam), at each of the dams during 2005. This information is derived from the data shown in Table 2. Table 11 shows the estimated number of fall Chinook salmon expected to outmigrate from each ESU.

SOCKEYE SALMON ESTIMATES

The sockeye salmon collection count at Lower Granite Dam was based on IDFG's estimate of wild and hatchery-reared sockeye salmon smolts exiting the upper Salmon River in 2005 and their estimates of survival to Lower Granite Dam. IDFG estimates that 5,567 wild fish and 21,517 hatchery fish that have overwintered in the lakes will survive to Lower Granite Dam in spring 2005. All of these fish are listed as endangered.

listed sockeye (wild and hatchery) to Lower Granite Dam =
IDFG's estimated wild fish + estimated hatchery fish =
27,084 = 5,567 + 21,517

To determine the percentage of wild sockeye salmon collected at Lower Granite Dam, we estimated the number of kokanee arriving at Lower Granite Dam. In 2004, we estimated that 710 wild Redfish Lake sockeye salmon would be collected at Lower Granite Dam. During that outmigration, spill from Dworshak Dam released kokanee that were collected at Lower Granite Dam. The total collection of wild *Oncorhynchus nerka* salmon at Lower Granite Dam for 2004 (through December 31, 2004) was 2,746, 2,036 of which (2,746 - 710) were kokanee. With an FGE of 0.710 (the 2004 estimate), 2,868 (2,036/0.710) kokanee reached Lower Granite Dam. Assuming the same amount of spill from Dworshak Dam in 2005 with a release of the same number of kokanee, we estimated the total number of wild *O. nerka* arriving at Lower Granite Dam to be 8,435 (2,868 + 5,567). We then estimated the percentage of wild *O. nerka* arriving at Lower Granite Dam that will be listed Snake River sockeye salmon.

% listed wild sockeye =
listed wild sockeye/total wild *O. nerka* to Lower Granite Dam =
66.0% = 5,567/8,435

A total of 29,952 (27,084 listed sockeye + 2,868 kokanee) *O. nerka* will arrive at Lower Granite Dam.

% total listed sockeye =
total listed sockeye/total *O. nerka* to Lower Granite Dam =
90.4% = 27,084/29,952

An FGE of 0.351 (average for 1998-2004 (excluding 2001)) was used to estimate the number of *O. nerka* smolts reaching Lower Granite Dam that will be collected.

O. nerka salmon collected = total *O. nerka* salmon x FGE =
10,513 = 29,952 x 0.351

Because of extreme year-to-year variability, the count used at McNary Dam for 2005 is based on the average of the counts at the dam from 1985 to 2004 (560,730). Project survival was set at the yearling Chinook salmon level (Table 2).

Summary

Table 7 presents a summary of the estimated number of fish that will be collected, or will be arriving (Columbia River dams above McNary Dam), at each of the dams during 2005. This information is derived from the data shown in Table 2. Table 11 shows the estimated number of sockeye salmon expected to outmigrate from the Snake River ESU.

STEELHEAD ESTIMATES

Introduction

Because of the time of year that steelhead spawn, it is very difficult to obtain redd count information. All of our steelhead estimates, not otherwise explained, are based on adult counts in the spawning areas. We assumed that 65% of the adults were females and that every female spawned successfully. To estimate the number of outmigrants, we used average fecundity estimates, and assigned an egg-to-smolt survival rate of 1%. This survival rate is conservative as all rates we calculated or found in the literature were from 0.5% to 0.75%.

Snake River Steelhead ESU

Prior to the 2001 outmigration, nearly all hatchery steelhead were fin-clipped, allowing us to use the juvenile collection numbers at Lower Granite Dam without making any adjustments for unclipped hatchery fish. Because it was known that a large number of unclipped steelhead were to be released for the 2004 outmigration, WDFW not only recorded the number of unclipped steelhead collected but also the number of unclipped steelhead that had fin erosion, a strong indicator that a fish is of hatchery origin. Based on the information provided by WDFW (Fred Mensik, WDFW, Pers. commun., January 2005), we determined that 552,869 wild steelhead were collected at Lower Granite Dam in 2004 (0.493, or 537,445, of the 1,090,314 unclipped steelhead collected at Lower Granite Dam in 2004 had fin erosion). We applied the 2004 estimated FGE (0.775) to the collection number to determine that 713,379 (552,869/0.775) wild steelhead arrived at Lower Granite Dam in 2004.

To our knowledge, no research has been conducted on the age-class distribution of migrating juvenile steelhead in the Snake River; however, there has been research on the mid-Columbia River (Pevan et al. 1994¹). Pevan's research showed that in the mid-Columbia River, migrating steelhead were 0.7% age-1, 43.2% age-2, 46.4% age-3, and 8.6% age-4 smolts. The age-class of the remainder of smolts (1.1%) was greater than age-4, up to age-7. Because of this age-class breakdown, we decided to base our estimates on age-classes 1 to 4. Because steelhead spawn in the spring, our annual counts were from July 1 to June 30, rather than by calendar year. Using the adult counts at Lower Granite Dam of the 4 years that comprised the 2004 wild smolt outmigration (2000-2003 brood years, July 1, 1999-June 30, 2003), and applying the smolt age-class percentages to the adult counts for each of

¹ Pevan, C. M., R. R. Whitney, and K. R. Williams. 1994. Age and length of steelhead smolts from the Mid-Columbia River Basin, Washington. N. Am. J. Fish. Manage. 14:77-86.

these 4 years, we estimated that 33,072 of the adults passing Lower Granite Dam produced the 2004 steelhead outmigration. We performed the same calculation to estimate the number of adults from the 4 years (2001-2004 brood years) producing the 2005 wild outmigration. We calculated that the 2005 wild outmigration will be based on 50,217 adults, or 151.8% of the number of fish producing the 2004 outmigration. We applied the change in the number of adults to the number of wild steelhead that arrived at Lower Granite Dam in 2004 (713,379) to determine the estimated 2005 arrival number.

$$\left(\begin{array}{c} \text{total wild steelhead} \\ \text{arriving at Lower Granite} \end{array} \right) = \left(\begin{array}{c} \text{wild steelhead} \\ \text{arriving in 2004} \end{array} \right) \times \left(\begin{array}{c} \% \text{ change between adult counts for} \\ \text{2004 and 2005 outmigrations} \end{array} \right) =$$

$$1,082,909 = 713,379 \times 1.518$$

For the steelhead hatchery release numbers, we used IDFG's, ODFW's, and WDFW's estimates of hatchery releases in Idaho, Oregon, and Washington. We estimate that 9,073,500 hatchery smolts (Table 4) will be released from Idaho (7,676,500), Oregon (1,057,000), and Washington (340,000 in the Grande Ronde River). In the Snake River above Lower Granite Dam, no hatchery steelhead are listed under the ESA.

In order to estimate how many hatchery smolts will reach Lower Granite Dam, we attempted to use the survival estimates for the 1993-2004 outmigrations (excluding 2001) (from the NMFS survival study, Research Action #1212). Survival estimates have been made for all but two hatchery release groups, releases into the Grande Ronde Basin from Irrigon and Lyons Ferry Hatcheries. We applied the survival estimate from Dworshak National Fish Hatchery (0.799) to these hatchery release groups. Using the 2005 projected release number and survival estimate for each hatchery, we estimated how many total hatchery fish will arrive at Lower Granite Dam. We estimate that 6,948,857 or 78.1341% of the 9,073,500 hatchery fish released will arrive at the dam (Table 4).

Knowing the numbers of hatchery and wild fish arriving at Lower Granite Dam, we estimated the percentage composition of listed wild fish arriving at the dam.

$$\begin{aligned} \text{total smolts} &= \text{total hatchery fish} + \text{wild fish} = \\ 8,031,766 &= 6,948,857 + 1,082,909 \end{aligned}$$

$$\begin{aligned} \% \text{ wild fish to Lower Granite Dam} &= \text{wild fish} / \text{total smolts} = \\ 13.48283\% &= 1,082,909 / 8,031,766 \end{aligned}$$

We set FGEs at Lower Granite and Little Goose Dams at 0.469 and 0.518, respectively. Using an FGE of 0.469, the total collection at Lower Granite Dam will be 3,766,898 (8,031,766 x 0.469), based on 8,031,766 smolts arriving at the dam. Wild and hatchery fish,

will comprise 507,884 ($1,082,909 \times 0.469$) and 3,259,014 ($3,766,898 - 507,884$) of the total collection, respectively.

Wild/natural Tucannon River drainage fish are listed within the Snake River ESU. In spring 2005, 25,000 wild fish are expected to outmigrate from the Tucannon River. In addition, 220,000 non-listed hatchery fish will be released into the Tucannon River or released directly from Lyons Ferry Hatchery. The Tucannon River joins the Snake River between Little Goose and Lower Monumental Dams. Because of the short distance from the confluence to Lower Monumental Dam, we assumed no mortality of these fish prior to Lower Monumental Dam. The estimates shown in Table 5 and Tables 9-10 reflect the addition of these fish above Lower Monumental Dam.

WDFW will release 137,000 non-listed hatchery steelhead into the Touchet River, a tributary of the Walla Walla River, and 100,000 non-listed hatchery steelhead (from Mid-Columbia River ESU stock) into the Walla Walla River. The Walla Walla River enters the Columbia River above McNary Dam. For these fish, survival to McNary Dam was set at 100%.

Except when research studies require an alternate disposition, all PIT-tagged fish bypassed at the collection dams (Lower Granite, Little Goose, Lower Monumental, and McNary Dams) are returned to the river to continue migrating inriver. This return of fish to the river requires adjustment of our estimates of the number of listed fish that reach McNary Dam. We estimated the number of fish that will be PIT tagged for 2005 and, as described in Appendix B, adjusted for fish diverted to transportation at each Snake River collector dam. A detailed description of how we estimated the impact of returning PIT-tagged fish to the river is presented in Appendix B. We estimated that 5,328 PIT-tagged steelhead from the Snake River (including 576 wild fish) will be collected at McNary Dam because they were returned to the river at an upstream dam(s). These numbers represent collected fish. Dividing the collected number by the FGE at McNary Dam (0.196), we determined that 2,941 wild Snake River steelhead ($576/0.196$) will arrive at McNary Dam and must be added to the number of fish that were estimated to reach McNary Dam as a result of not having been collected at an upstream dam (column "Listed fish to McNary", Table 5).

Upper-Columbia River ESU Steelhead

Very little is known regarding wild steelhead in the Columbia River above the confluence with the Yakima River. Also, little is known regarding dam passage of smolts at the dams above McNary Dam. Because of this lack of information, the estimates of wild steelhead from the listed Upper Columbia River ESU are based on what little information is available and on broad generalizations based on this information. No FGE's have been established for the dams in this reach, so the numbers presented in this section of the memorandum (and in Tables 9 and 10) are the number of fish

arriving at the dam, not collection numbers (unless otherwise noted in the text).

As mentioned above, Pevan et al. (1994) showed that migrating steelhead were 0.7% age-1, 43.2% age-2, 46.4% age-3, and 8.6% age-4 smolts. The age-class of the remainder of smolts (1.1%) was greater than age-4, up to age-7. Because of this age-class breakdown, we decided to base our estimates on age-classes 1 to 4.

We based our estimates of wild fish on counts collected at Rock Island Dam by the Fish Passage Center. During the 2004 outmigration, 5,285 wild steelhead smolts were counted in the Smolt Monitoring Program's sample. It is estimated that the sample represents 3-5% of the fish passing the dam. Using a 4% sample rate, we estimated that 132,125 wild steelhead passed Rock Island Dam in 2004.

We then examined the adult counts at Rock Island Dam. Because steelhead spawn in the spring, our annual counts were from July 1 to June 30, rather than by calendar year. Using the adult counts of the 4 years that comprised the 2004 wild smolt outmigration (2000-2003 brood years, July 1, 1999-June 30, 2003), and applying the smolt age-class percentages to the adult counts for each of these 4 years, we estimated that 17,850 of the adults passing Rock Island Dam produced the 2004 steelhead outmigration. We performed the same calculation to estimate the number of adults from the 4 years (2001-2004 brood years) producing the 2005 wild outmigration. We calculated that the 2005 wild outmigration will be based on 20,653 adults, or 1.157 of the number of fish producing the 2004 outmigration. We applied the change in the number of adults to the 2004 Rock Island Dam collection to arrive at the estimated 2005 collection number.

$$\left(\begin{array}{c} \text{total wild steelhead} \\ \text{collected at Rock Island} \end{array} \right) = \left(\begin{array}{c} \text{wild steelhead} \\ \text{collected in 2004} \end{array} \right) \times \left(\begin{array}{c} \% \text{ change between adult counts} \\ \text{for 2004 and 2005 outmigrations} \end{array} \right) =$$
$$6,115 = 5,285 \times 1.157$$

Since this represents 4% of the fish passing the dam, we estimate that 152,875 wild steelhead smolts will pass the dam in 2005. Using the smolt age-class percentages, we estimate that 1,070 smolts will be age-1, 66,042 will be age-2, 70,934 will be age-3, and 13,147 will be age-4.

To determine the number of wild smolts passing the two dams above Rock Island Dam (Rocky Reach and Wells Dams), we used the estimate of wild smolts passing Rock Island Dam (152,875) and the adult counts at all three dams.

By comparing the adult counts at each of the three dams for the 4 years that will produce the 2005 outmigration (2001-2004), we calculated the number of adults "lost" between each dam. We

assigned this "loss" to adults migrating up rivers between the dams. The difference in adult counts between dams varied between years, so we applied the age-class percentages to each year's differences between dams to determine the number of wild smolts added from the rivers between the dams.

From Rock Island Dam to McNary Dam, the only adjustment made to the wild steelhead smolt count was for per-project survival (0.9%).

To determine the number of hatchery smolts arriving at each dam in 2005, we used the outplanting data for the 3 years comprising the 2005 outmigration (2003-2005). Because hatchery fish are larger than equivalent age-class wild fish, we assigned age-2 status to hatchery fish released in 2005, age-3 to those released in 2004, and age-4 to those released in 2003. All of the hatchery outplants will be of listed hatchery stocks.

Because there are no survival data for the various hatcheries releasing fish in this section of the Columbia River, we assumed that all fish released survived to the first dam. We again applied the age-class percentages to the number of fish released each of the 3 years to determine the number of hatchery fish that would outmigrate in 2005. Beginning at Wells Dam and assuming 90% per-project survival, we determined both the number of listed hatchery and the total number of hatchery fish reaching each dam through McNary Dam (Tables 5 and 9).

Mid-Columbia River ESU Steelhead

The Mid-Columbia River wild summer-run and winter-run steelhead are listed protected species. There are no listed hatchery stocks in this ESU. Only summer steelhead from the Yakima and Walla Walla Rivers enter the Columbia River above McNary Dam. Because we received no new information on wild fish production from this ESU, this year's wild estimates are the same as last year.

Based on our assumptions described in the steelhead introduction, 90,370 wild summer steelhead will enter above McNary Dam in 2005. An additional 228,114 wild and 155,000 unlisted hatchery summer steelhead from this ESU will be added between McNary and John Day Dams, and 65,160 wild and 160,000 unlisted hatchery summer steelhead will be added between John Day and The Dalles Dams.

Estimate of Fish Arriving at McNary Dam

McNary Dam is the first dam on the Columbia River below the confluence of the Snake River. To obtain an estimate of the number of steelhead smolts arriving at McNary Dam, we added the estimated numbers from the Upper Columbia River (820,832), Mid-Columbia (90,370) and the Snake River (1,090,374) ESUs.

We estimate that 2,001,576 (820,832 + 90,370 + 1,090,374) steelhead smolts will arrive at McNary Dam in 2005, and that 392,309 fish will be collected. Of the 392,309 smolts collected at McNary Dam, 61,285 (0.156) will be wild (21,843 Upper Columbia River ESU, 21,729 Snake River ESU, and 17,713 Mid-Columbia River ESU), 134,006 (0.342) will be listed hatchery (all from the Upper Columbia River ESU), and 197,018 (0.502) will be unlisted hatchery fish (5,033 Columbia River and 191,985 Snake River). The ratio of Upper Columbia River ESU wild fish, Snake River ESU wild fish and Mid-Columbia River ESU wild fish at McNary, John Day, and The Dalles Dams will be

	McNary Dam		John Day		The Dalles	
Upper Columbia	35.6	(21,843)	18.7	(80,643)	16.2	(72,579)
SNAKE RIVER	35.5	(21,729)	18.6	(80,218)	16.2	(72,196)
Mid-Columbia						
Summer	28.9	(17,713)	62.7	(270,694)	67.6	(302,269)
winter		—		—		—

All listed hatchery fish are from the Upper Columbia River ESU.

Lower Columbia River ESU

We estimate that 47,074 wild steelhead from this ESU will arrive at Bonneville Dam. The effects of this are shown in the "Bonneville Dam" lines in Tables 9 and 10. The ratio of the various ESUs will be

	Bonneville Dam	
Upper Columbia	14.0	(65,321)
SNAKE RIVER	13.9	(64,976)
Mid-Columbia		
summer	58.4	(272,042)
winter	3.6	(16,557)
Lower Columbia	10.1	(47,074)

Another 216,758 wild steelhead are expected to enter the Columbia River from Washington and Oregon downstream from Bonneville Dam to the Cowlitz River.

Fish transported from Snake River dams and McNary Dam are released below Bonneville Dam. The number of listed transport fish returned to the river will be 913,752 (913,752 wild), 155,644 (21,638 wild and 134,006 listed hatchery), and 17,546 (all wild) for the Snake River, Upper Columbia River, and Mid-Columbia River (summer-run) ESUs, respectively. A total of 7,032,262 transported steelhead will be released below Bonneville Dam.

Upper Willamette River ESU

The Upper Willamette River wild winter-run steelhead are listed protected species. There are no listed hatchery stocks in this ESU.

Based on our assumptions described in the steelhead introduction, 285,256 winter steelhead will enter the Columbia River in 2005, 216,784 of which will be from listed stocks.

At Tongue Point the ratios of the various ESUs will be

Tongue Point

Upper Columbia	4.7	(86,959)
Snake River	52.8	(978,728)
Mid-Columbia		
summer	15.6	(289,588)
winter	0.9	(16,557)
Lower Columbia	14.2	(263,832)
Upper Willamette	11.7	(216,784)

All listed hatchery fish are from the Upper Columbia River ESU.

Summary

Tables 9 and 10 summarize the estimated number of steelhead that will be collected, or will be arriving (Columbia River dams above McNary Dam), at each of the collection dams during 2005. This information is derived from the data shown in Tables 4-5 and Appendix Table B1. Table 11 shows the estimated number of steelhead expected to outmigrate from each ESU.

CHUM ESTIMATES

Columbia River ESU

Wild chum salmon in the Columbia River are listed protected species. No hatchery fish are listed.

The chum salmon adult count at Bonneville Dam in 2004 (47) was the lowest of the past 4 years. Preliminary data indicate that chum salmon numbers at Ives Island were 36% of those seen in 2003. Most other sites are not shown in state and federal reports (only 7 of the 28 sites reported last year). Because of the lack of data, we cannot make an estimate of listed chum salmon. We expect the hatchery chum salmon outmigration to be 100,000 from the Columbia River, 100,000 from Chinook River, and 250,000 from Grays River.

Full Transportation Scenario

The estimates shown in Table 3 were derived using the same methodology utilized under the Transportation with Spill Scenario, with one major difference. The number of fish removed at each dam under the Transportation with Spill Scenario was based on an FGE value that adjusted for spill. For our estimates under the Full Transportation Scenario, we used the FGE values developed during developmental testing of the diversion screens installed in each of the turbine intakes. Using the results from these tests, the FGEs for spring/summer Chinook salmon and sockeye salmon were changed from the values in Table 2 to 60.0%, 65.0%, 50.0%, and 80.0% at Lower Granite, Little Goose, Lower Monumental, and McNary Dams, respectively. Subyearling fall Chinook salmon FGEs were changed from the values in Table 2 to 55.0%, 60.0%, 40.0%, and 65.0% at Lower Granite, Little Goose, Lower Monumental, and McNary Dams, respectively. Steelhead FGEs (in Table 6) were changed from the values in Table 5 to 80.0%, 90.0%, 65.0%, and 90.0% at Lower Granite, Little Goose, Lower Monumental, and McNary Dams, respectively. Using the same formulas as under the Transportation with Spill Scenario, we derived the values found in Tables 3 and 6-10.

Because the adjusted FGE at Lower Granite Dam was changed from 41.8% to 60.0% for yearling spring/summer Chinook and sockeye salmon, the total number of fish collected at Lower Granite Dam will be 5,754,460 (9,590,767 x 0.60) spring/summer Chinook salmon and 17,971 (29,952 x 0.60) *O. nerka* salmon.

Because more PIT-tagged fish will be collected at the upstream dams, the number of PIT-tagged fish that are returned to the river and subsequently collected at McNary Dam will be different under this scenario. The effects of this are shown in Appendices A and B.

As under the Transportation with Spill Scenario, to estimate the number of spring/summer Chinook salmon smolts arriving at McNary Dam, we added the estimated numbers from the Columbia River above McNary (4,203,527) and the Snake River (727,114).

$$4,203,527 + 727,114 = 4,930,641$$

Tables 7-10 show the changes in percentages of listed fish at each dam.

Table 1. Estimated percentage composition of Snake River spring/summer Chinook salmon arriving at Lower Granite Dam from listed hatcheries compared with total hatchery releases projected for spring 2005.

Hatchery	Total hatchery releases ^a 2005	Survival to <u>Lower Granite Dam</u> Mean ^b	Fish to Lower Granite Dam
Dworshak ^c	1,270,604	0.778	988,530
Kooskia ^c	620,000	0.671	416,020
Lookingglass			
Imnaha ^d	437,000	0.647	282,739
Grande Ronde ^d	586,900	0.622	365,052
Clearwater ^c	1,843,967	0.605	1,115,600
Rapid River ^c	3,383,923	0.645	2,182,630
Sawtooth ^d	135,000	0.401	54,135
McCall ^{c,d}	1,375,000	0.541	743,875
Pahsimeroi ^c	1,000,000	0.583	583,000
Nez Perce ^c	75,000	0.605	45,375
Totals			
All stocks	10,727,394		6,776,956
Listed stocks	1,263,900		758,731
Percent of listed stocks	11.78199%		11.19575%

^a Data from IDFG and ODFW.

^b Mean survival estimate made from PIT-tag detections of marked hatchery fish releases as part of the NMFS survival studies (Research Action #1212) for 1993-2004 (excluding 2001).

^c Non-listed stocks.

^d Listed stocks in 2005 (only 105,000 of the 1,375,000 McCall Hatchery fish are listed).

Table 2. Estimate of listed threatened and endangered species arriving at various locations during outmigration year 2005 under past transportation and spill conditions.

Yearling spring/summer Chinook salmon

Snake River ESU

Rearing type	<u>Total Collection*</u>		Of Granite % Listed Fish	Total Listed Fish to Granite ^a	Granite	Goose	<u>FGE¹</u>		McNary	Project Survival	Listed fish to McNary ^b	<u>Of Fish Collected at McNary</u>	
	Granite	McNary					Low	Mon**				Listed Fish	% Listed Fish
Wild	4,008,941	2,213,713	29.339	2,813,811	0.418	0.458	0.354		0.384	0.9	427,592	164,195	7.42
Listed hatchery***	4,008,941	2,213,713	7.911	758,731	0.418	0.458	0.354		0.384	0.9	232,693	89,354	4.04

Upper Columbia River ESU

Rearing type	<u>Number of listed fish passing dam</u>			<u>Of dam total, % listed fish</u>			FGE McNary	Project Survival	Listed fish to McNary ^b	<u>Of Fish Collected at McNary</u>	
	Wells	Rocky Reach	Rock Island	Wells	Rocky Reach	Rock Island				Listed Fish	% Listed Fish
Wild****	337,725	393,728	727,705	31.6	28.9	24.6	0.384	0.9	530,498	203,711	9.20
Listed hatchery	582,259	524,033	705,130	54.4	38.4	23.8	0.384	0.9	514,040	197,391	8.92

Subyearling fall Chinook salmon

Rearing type	<u>Total Collection*</u>		Of Granite % Listed Fish	Total Listed Fish to Granite ^a	Granite	Goose	<u>FGE¹</u>		McNary	Project Survival	Listed fish to McNary ^b	<u>Of Fish Collected at McNary</u>	
	Granite	McNary					Low	Mon				Listed Fish	% Listed Fish
Wild****	1,270,615	12,305,972	25.397	595,392	0.542	0.510	0.459		0.509	0.75	32,002	16,289	0.13

Sockeye salmon

Rearing type	<u>Total Collection*</u>		Of Granite % Listed Fish	Total Listed Fish to Granite ^a	Granite	Goose	<u>FGE¹</u>		McNary	Project Survival	Listed fish to McNary ^b	<u>Of Fish Collected at McNary</u>	
	Granite	McNary					Low	Mon				Listed Fish	% Listed Fish
Wild and listed hatchery*****	10,513	560,730	90.4	27,084	0.351	0.408	0.395		0.255	0.9	4,131	1,053	0.19

*Note: Total Collection is the total number of fish collected of that species or run, regardless of rearing type.

**Note: Listed wild and hatchery spring Chinook salmon enter the Snake River above Lower Monumental Dam. WDFW predicts that 30,000 wild and 190,000 listed hatchery fish will outmigrate from the Tucannon River and Lyons Ferry Fish Hatchery in 2005 (Michael Gallinat, WDFW, Pers. commun., February 2005)

***Note: Based on 2005 hatchery releases, it was estimated that 11.19575% of the hatchery fish arriving at Lower Granite Dam are products of a listed hatchery (Table 1). Because Table 2 is based on the total collection at Lower Granite Dam, which includes both wild and hatchery (listed and unlisted) fish, this estimate of 11.19575% of all hatchery fish was adjusted to 7.911% of the total collection at Lower Granite Dam.

****Note: Estimated values based on the average collection numbers from 1995-2004 (excluding 2001) (Fish Passage Center Weekly Reports), and on the average number of adult returns from 1994-2004 (excluding 2001) and the 2004 adult returns (FPC Weekly Reports 1994-2004).

*****Note: The Lower Granite Dam estimate is based on IDFG's estimate of 5,567 wild sockeye salmon smolts and 21,517 hatchery fish that overwintered in the lakes arriving at Lower Granite Dam in 2005 (Catherine Willard, IDFG, Pers. commun., February 2005). The McNary Dam estimate is the average collection count at McNary Dam from 1985-2004 (Annual Fish Passage Reports 1985-2004, and WDFW's 2004 fish counts).

1 The FGE used in this table is adjusted for spill conditions, and PIT-tag detection efficiency at a dam. This estimate was obtained from the NMFS survival studies conducted in 1995-2004 (excluding 2001) (Steven G. Smith, NMFS, Pers. commun., February 2005).

Table 2. Estimate of listed threatened and endangered species arriving at various locations during outmigration year 2005 under past transportation and spill conditions.

a) Listed fish to Granite = $((\text{Collection}_{\text{Granite}})/(\text{FGE}_{\text{Granite}})) \times (\text{Of Granite Total \% Listed Fish})$

b) Listed Fish to McNary = $(\text{Listed Fish to Granite}) \times (1 - \text{FGE}_{\text{Granite}}) \times (\text{Project Survival}) \times (1 - \text{FGE}_{\text{Goose}}) \times (\text{Project Survival}) \times (1 - \text{FGE}_{\text{Low Mon}}) \times (\text{Project Survival})^2 +$
 $(\text{listed Tucannon fish}) \times (1 - \text{FGE}_{\text{Low Mon}}) \times (\text{Project Survival})^2 + (\text{PIT-tagged fish})$

where: listed Tucannon fish = 30,000 wild and 190,000 hatchery

PIT-tagged fish = fish collected at Snake River dams, returned to the river, and subsequently arrived at McNary Dam; See Appendix Table A1.

Table 3. Estimate of listed threatened and endangered species arriving at various locations during outmigration year 2005 under full transportation conditions (no spill).

Yearling spring/summer Chinook salmon

Snake River ESU

Rearing type	<u>Total Collection*</u>		Of Granite % Listed Fish	Total Listed Fish to Granite ^a	Granite	Goose	<u>FGE</u>		McNary	Project Survival	Listed fish to McNary ^b	<u>Of Fish Collected at McNary</u>	
	Granite	McNary					Low	Mon**				Listed Fish	% Listed Fish
Wild	5,754,460	3,944,513	29.339	2,813,811	0.60	0.65	0.50		0.80	0.9	183,531	146,825	3.72
Listed hatchery***	5,754,460	3,944,513	7.911	758,731	0.60	0.65	0.50		0.80	0.9	150,399	120,319	3.05

Upper Columbia River ESU

Rearing type	<u>Number of listed fish passing dam</u>			<u>Of dam total, % listed fish</u>			FGE McNary	Project Survival	Listed fish to McNary ^b	<u>Of Fish Collected at McNary</u>	
	Wells	Rocky Reach	Rock Island	Wells	Rocky Reach	Rock Island				Listed Fish	% Listed Fish
Wild****	337,725	393,728	727,705	31.6	28.9	24.6	0.80	0.9	530,498	424,398	10.76
Listed hatchery	582,259	524,033	705,130	54.4	38.4	23.8	0.80	0.9	514,040	411,232	10.43

Subyearling fall Chinook salmon

Rearing type	<u>Total Collection*</u>		Of Granite % Listed Fish	Total Listed Fish to Granite ^a	Granite	Goose	<u>FGE</u>		McNary	Project Survival	Listed fish to McNary ^b	<u>Of Fish Collected at McNary</u>	
	Granite	McNary					Low	Mon				Listed Fish	% Listed Fish
Wild****	1,289,369	15,715,478	25.397	595,392	0.55	0.60	0.40		0.65	0.75	30,471	19,806	0.13

Sockeye salmon

Rearing type	<u>Total Collection*</u>		Of Granite % Listed Fish	Total Listed Fish to Granite ^a	Granite	Goose	<u>FGE</u>		McNary	Project Survival	Listed fish to McNary ^b	<u>Of Fish Collected at McNary</u>	
	Granite	McNary					Low	Mon				Listed Fish	% Listed Fish
Wild and listed hatchery*****	17,971	560,730	90.4	27,084	0.60	0.65	0.50		0.80	0.9	1,244	995	0.18

*Note: Total Collection is the total number of fish collected of that species or run, regardless of rearing type.

**Note: Listed wild and hatchery spring Chinook salmon enter the Snake River above Lower Monumental Dam. WDFW predicts that 30,000 wild and 190,000 listed hatchery fish will outmigrate from the Tucannon River and Lyons Ferry Fish Hatchery in 2005 (Michael Gallinat, WDFW, Pers. commun., February 2005)

***Note: Based on 2005 hatchery releases, it was estimated that 11.19575% of the hatchery fish arriving at Lower Granite Dam are products of a listed hatchery (Table 1). Because Table 2 is based on the total collection at Lower Granite Dam, which includes both wild and hatchery (listed and unlisted) fish, this estimate of 11.19575% of all hatchery fish was adjusted to 7.911% of the total collection at Lower Granite Dam.

****Note: Estimated values based on the average collection numbers from 1995-2004 (excluding 2001) (Fish Passage Center Weekly Reports), and on the average number of adult returns from 1994-2004 (excluding 2001) and the 2004 adult returns (FPC Weekly Reports 1994-2004).

*****Note: The Lower Granite Dam estimate is based on IDFG's estimate of 5,567 wild sockeye salmon smolts and 21,517 hatchery fish that overwintered in the lakes arriving at Lower Granite Dam in 2005 (Catherine Willard, IDFG, Pers. commun., February 2005). The McNary Dam estimate is the average collection count at McNary Dam from 1985-2004 (Annual Fish Passage Reports 1985-2004, and WDFW's 2004 fish counts).

Table 3. Estimate of listed threatened and endangered species arriving at various locations during outmigration year 2005 under full transportation conditions (no spill).

Formulas:

$$a) \text{ Listed fish to Granite} = ((\text{Collection}_{\text{Granite}}) / (\text{FGE}_{\text{Granite}})) \times (\text{Of Granite Total \% Listed Fish})$$

$$b) \text{ Listed Fish to McNary} = (\text{Listed Fish to Granite}) \times (1 - \text{FGE}_{\text{Granite}}) \times (\text{Project Survival}) \times (1 - \text{FGE}_{\text{DooBee}}) \times (\text{Project Survival}) \times (1 - \text{FGE}_{\text{Low Mon}}) \times (\text{Project Survival})^2 + (\text{listed Tucannon fish}) \times (1 - \text{FGE}_{\text{Low Mon}}) \times (\text{Project Survival})^2 + (\text{PIT-tagged fish})$$

where: listed Tucannon fish = 30,000 wild and 190,000 hatchery

PIT-tagged fish = fish collected at Snake River dams, returned to the river, and subsequently arrived at McNary Dam; See Appendix Table A1.

Table 4. Estimated percentage composition of Snake River steelhead arriving at Lower Granite Dam from total hatchery releases projected for spring 2005. No hatchery in the Snake River ESU above Lower Granite Dam is listed.

Hatchery	Total hatchery releases ^a 2005	Survival to <u>Lower Granite Dam</u> Mean	Fish to Lower Granite Dam
Dworshak	2,000,000	0.799 ^b	1,598,000
Clearwater	843,000	0.677 ^b	570,711
Hagerman	1,290,000	0.702 ^b	905,580
Magic Valley	1,743,500	0.818 ^b	1,426,183
Niagara Springs	1,800,000	0.820 ^b	1,476,000
Irrigon (released above Lower Granite Dam)	877,000	0.799 ⁰	700,723
Lyons Ferry (released into Grande Ronde)	340,000	0.799 ^c	271,660
Totals All stocks	8,893,500		6,948,857

^a Data from IDFG, ODFW, USFWS, and WDFW.

^b Survival estimate made from PIT-tag detections of marked hatchery fish releases as part of the NMFS survival studies (Research Action #1212) for 1999-2004 (excluding 2001).

^c These hatcheries have no survival estimates from the NMFS survival studies, so they were set to the survival estimate of Dworshak National Fish Hatchery.

Table 5. Estimates of listed threatened and endangered steelhead arriving at various locations during outmigration year 2005 under past transportation and spill conditions.

Snake River ESU

Rearing type	<u>Total Collection*</u>		Of Granite Total % Listed Fish	Listed Fish to Granite ^a	Granite	Goose	<u>FGE¹</u>		McNary	Project Survival	Listed fish to McNary ^b	<u>Of Fish Collected at McNary</u>	
	Granite	McNary					Low	Mon**				Listed Fish	% Listed Fish
Wild	3,766,898	392,308	13.4828	1,082,909	0.469	0.518	0.466		0.196	0.9	110,860	21,729	5.54
Endemic (unlisted) hatchery	(For some, first dam reached is Lower Monumental Dam; for others, McNary Dam)								0.196	0.9	0	0	0.00

Upper Columbia River ESU

Rearing type	<u>Number of listed fish passing dam</u>			<u>Of dam total, % listed fish</u>			FGE ¹ McNary	Project Survival	Listed fish to McNary ^b	<u>Of Fish Collected at McNary</u>	
	Wells	Rocky Reach	Rock Island	Wells	Rocky Reach	Rock Island				Listed Fish	% Listed Fish
Wild***	111,730	133,327	152,875	18.7	19.4	16.1	0.196	0.9	111,446	21,843	5.57
Listed hatchery	486,482	544,668	785,059	81.3	79.2	82.9	0.196	0.9	683,704	134,006	34.16

Mid-Columbia River ESU

Rearing type	<u>Total Collection*</u>		Of Granite Total % Listed Fish	Listed Fish to Granite ^a	Granite	Goose	<u>FGE¹</u>		McNary	Project Survival	Listed fish to McNary ^b	<u>Of Fish Collected at McNary</u>	
	Granite	McNary					Low	Mon**				Listed Fish	% Listed Fish
Summer-run	(First dam reached is McNary Dam)								0.196	0.9	90,370	17,713	4.52
Winter-run	(First dam reached is Bonneville Dam)												

*Note: Total Collection is the total number of fish collected of that species or run, regardless of rearing type.

**Note: Hatchery steelhead and listed wild steelhead enter the Snake River above Lower Monumental Dam. WDFW predicts that 25,000 wild fish and endemic and 220,000 non-listed hatchery fish will outmigrate from the Tucannon River and Lyons Ferry Fish Hatchery in 2005. An additional 0 endemic and 237,000 non-listed Snake River hatchery steelhead will outmigrate from the Touchet and Walla Walla Rivers above McNary Dam (Michael Gillanet, WDFW, Pers. commun., February 2005).

***Note: Estimated values based on 2004 collection numbers (Fish Passage Center Weekly Reports), and on the number of adult returns from 1995-2004 (FPC Weekly Reports 1995-2004).

1 The FGE used in this table is adjusted for spill conditions, and PIT-tag detection efficiency at a dam. This estimate was obtained from the NMFS survival studies conducted in 1995-2004 (excluding 2001) (Steven G. Smith, NMFS, Pers. commun., February 2005).

Formulas:

a) Listed fish to Granite = ((Collection_{Granite})/(FGE_{Granite}))x(Of Granite Total % Listed Fish)

b) Listed Fish to McNary = (Listed Fish to Granite)x(1-FGE_{Granite})x(Project Survival)x(1-FGE_{Goose})x(Project Survival)x(1-FGE_{Low Mon})x(Project Survival)² + (listed Tucannon fish)x(1-FGE_{Low Mon})x(Project Survival)² + (Rock Island listed fish)x(Project Survival)² + (PIT-tagged fish)

where: listed Tucannon fish = 25,000 wild

PIT-tagged fish = fish collected at Snake River dams, returned to the river, and subsequently arrived at McNary Dam; See Appendix Table B1.

Table 6. Estimates of listed threatened and endangered steelhead arriving at various locations during outmigration year 2005 under full transportation conditions (no spill).

SNAKE RIVER ESU

Rearing type	<u>Total Collection*</u>		Of Granite Total % Listed Fish	Listed Fish to Granite ^a	<u>FGE</u>				Project Survival	Listed fish to McNary ^b	<u>Of Fish Collected at McNary</u>	
	Granite	McNary			Granite	Goose	Low	Mon**			Listed Fish	% Listed Fish
Wild	6,425,413	1,159,400	13.4828	1,082,909	0.80	0.90	0.65	0.90	0.9	15,492	13,943	1.20
Endemic (unlisted) hatchery	(For some, first dam reached is Lower Monumental Dam; for others, McNary Dam)								0.90	0.9	0	0.00

UPPER COLUMBIA RIVER ESU

Rearing type	<u>Number of listed fish passing dam</u>			<u>Of dam total, % listed fish</u>			<u>FGE</u> McNary	Project Survival	Listed fish to McNary ^b	<u>Of Fish Collected at McNary</u>	
	Wells	Rocky Reach	Rock Island	Wells	Rocky Reach	Rock Island				Listed Fish	% Listed Fish
Wild***	111,730	133,327	152,875	18.7	19.4	16.1	0.90	0.9	111,446	100,301	8.65
Listed hatchery	486,482	544,668	785,059	81.3	79.2	82.9	0.90	0.9	683,704	615,334	53.07

MID-COLUMBIA RIVER ESU

Rearing type	Of Fish Collected		Of Granite Total % Listed Fish	Listed Fish to Granite ^a	FGE				Project Survival	Listed fish to McNary ^b	at McNary			
	Total Collection*				Granite	Goose	Low	Mon**			McNary	Listed Fish	% Listed Fish	
Summer-run	Granite	McNary												
	(First dam reached is McNary Dam)									0.90	0.9	90,370	81,333	7.02
Winter-run	(First dam reached is Bonneville Dam)													

*Note: Total Collection is the total number of fish collected of that species or run, regardless of rearing type.

**Note: Hatchery steelhead and listed wild steelhead enter the Snake River above Lower Monumental Dam. WDFW predicts that 25,000 wild fish and endemic and 220,000 non-listed hatchery fish will outmigrate from the Tucannon River and Lyons Ferry Fish Hatchery in 2005. An additional 0 endemic and 237,000 non-listed Snake River hatchery steelhead will outmigrate from the Touchet and Walla Walla Rivers above McNary Dam (Michael Gillanet, WDFW, Pers. commun., February 2005).

***Note: Estimated values based on 2004 collection numbers (Fish Passage Center Weekly Reports), and on the number of adult returns from 1995-2004 (FPC Weekly Reports 1995-2004).

Formulas:

a) Listed fish to Granite = ((Collection_{Granite})/(FGE_{Granite}))x(Of Granite Total % Listed Fish)

b) Listed Fish to McNary = (Listed Fish to Granite)x(1-FGE_{Granite})x(Project Survival)x(1-FGE_{Goose})x(Project Survival)x(1-FGE_{Low Mon})x(Project Survival)² + (listed Tucannon fish)x(1-FGE_{Low Mon})x(Project Survival)² + (Rock Island listed fish)x(Project Survival)² + (PIT-tagged fish)

where: listed Tucannon fish = 25,000 wild

PIT-tagged fish = fish collected at Snake River dams, returned to the river, and subsequently arrived at McNary Dam; See Appendix Table B1.

Table 7. Juvenile collection at each of eight mainstem collection facilities in 2005 under full transportation and transportation with spill scenarios.

	Full Transportation Scenario				Transportation with Spill Scenario			
	Chinook salmon		Sockeye salmon		Chinook salmon		Sockeye salmon	
	Spring/Summer	Fall			Spring/Summer	Fall		
	Wild	Hatchery	Subyearling		Wild	Hatchery	Subyearling	
Total fish collected at:*								
Lower Granite	5,754,460	5,754,460	1,289,369	17,971	4,008,941	4,008,941	1,270,615	10,513
Little Goose	2,290,124	2,290,124	474,722	7,009	2,323,352	2,323,352	413,103	7,138
Lower Monumental	757,579	757,579	186,944	1,698	1,000,816	1,000,816	240,573	3,682
Ice Harbor**	484,742	484,742	94,640	917	1,040,898	1,040,898	95,699	3,045
<u>Columbia River</u>								
Wells***	1,069,984	1,069,984	NA	NA	1,069,984	1,069,984	NA	NA
Rocky Reach***	1,363,961	1,363,961	NA	NA	1,363,961	1,363,961	NA	NA
Rock Island***	2,962,515	2,962,515	NA	NA	2,962,515	2,962,515	NA	NA
Wanapum***	2,666,264	2,666,264	NA	NA	2,666,264	2,666,264	NA	NA
Priest Rapids***	2,399,638	2,399,638	NA	NA	2,399,638	2,399,638	NA	NA
McNary****	3,944,513	3,944,513	15,715,478	560,730	2,213,713	2,213,713	12,305,972	560,730
John Day** ****	1,507,569	1,507,569	9,474,428	884,634	674,961	674,961	7,405,531	179,876
The Dalles** ****	1,513,448	1,513,448	5,075,586	530,780	2,344,520	2,344,520	4,613,080	530,782
Bonneville (I & II combined)** *****	2,582,103	2,582,103	6,486,386	477,702	1,623,408	1,623,408	4,916,806	212,578
---To the tailrace of Bonneville	6,455,258	6,455,258	21,621,287	1,194,255	8,325,169	8,325,169	20,233,770	1,194,258
---To Tongue Point*****	37,284,545	37,284,545	51,474,652	1,781,663	36,121,368	36,121,368	46,650,885	1,776,321
Total listed fish at:								
Lower Granite	1,688,284	455,237	327,466	16,250	1,176,171	317,149	322,702	9,506
Little Goose	679,472	185,961	120,567	6,338	685,361	186,152	104,917	6,454
Lower Monumental	198,055	157,580	36,113	1,536	278,209	146,318	48,057	3,329
Ice Harbor**	122,354	100,266	18,282	829	285,060	155,130	19,117	2,753
<u>Columbia River</u>								
Wells***	337,725	582,259	NA	NA	337,725	582,259	NA	NA
Rocky Reach***	393,728	524,033	NA	NA	393,728	524,033	NA	NA
Rock Island***	727,705	705,130	NA	NA	727,705	705,130	NA	NA
Wanapum***	654,935	634,617	NA	NA	654,935	634,617	NA	NA
Priest Rapids***	589,442	571,155	NA	NA	589,442	571,155	NA	NA
McNary****	571,223	531,551	19,806	995	367,906	286,745	16,289	1,053
John Day** ****	77,115	71,759	2,800	134	74,363	57,958	3,547	338
The Dalles** ****	46,269	43,055	1,500	80	191,219	149,035	2,210	997
Bonneville (I & II combined)** *****	41,642	38,750	119,708	72	83,897	65,389	97,481	399
---To the tailrace of Bonneville	104,105	96,875	399,027	180	430,241	335,328	401,156	2,242
---To Tongue Point*****	12,481,349	1,368,343	13,089,831	25,299	12,219,259	1,244,906	9,070,862	22,584

Table 7. (Cont'd) Juvenile collection at each of eight mainstem collection facilities in 2005 under full transportation and transportation with spill scenarios.

	Full Transportation Scenario				Transportation with Spill Scenario			
	Chinook salmon		Sockeye Salmon		Chinook salmon		Sockeye Salmon	
	Spring/Summer	Fall			Spring/Summer	Fall		
	Wild	Hatchery	Subyearling		Wild	Hatchery	Subyearling	
Percent listed fish at:								
Lower Granite	29.34%	7.91%	25.40%	90.42%	29.34%	7.91%	25.40%	90.42%
Little Goose	29.67%	8.12%	25.40%	90.43%	29.50%	8.01%	25.40%	90.42%
Lower Monumental	26.14%	20.80%	19.32%	90.46%	27.80%	14.62%	19.98%	90.41%
Ice Harbor**	25.24%	20.68%	19.32%	90.40%	27.39%	14.90%	19.98%	90.41%
<u>Columbia River</u>								
Wells***	31.56%	54.42%	NA	NA	31.56%	54.42%	NA	NA
Rocky Reach***	28.87%	38.42%	NA	NA	28.87%	38.42%	NA	NA
Rock Island***	24.56%	23.80%	NA	NA	24.56%	23.80%	NA	NA
Wanapum***	24.56%	23.80%	NA	NA	24.56%	23.80%	NA	NA
Priest Rapids***	24.56%	23.80%	NA	NA	24.56%	23.80%	NA	NA
McNary****	14.48%	13.48%	0.13%	0.18%	16.62%	12.95%	0.13%	0.19%
John Day** ****	5.12%	4.76%	0.03%	0.02%	11.02%	8.59%	0.05%	0.19%
The Dalles** ****	3.06%	2.84%	0.03%	0.02%	8.16%	6.36%	0.05%	0.19%
Bonneville (I & II combined)** *****	1.61%	1.50%	1.85%	0.02%	5.17%	4.03%	1.98%	0.19%
---To the tailrace of Bonneville	1.61%	1.50%	1.85%	0.02%	5.17%	4.03%	1.98%	0.19%
---To Tongue Point*****	33.48%	3.67%	25.43%	1.42%	33.83%	3.45%	19.44%	1.27%

* Note: "Total fish collected at:" is the total number of fish collected of that species or run, regardless of rearing type.

** Note: These dams have no transportation facilities, therefore, no fish are removed from the river at these dams.

***Note: The numbers shown for these dams represent the number of fish arriving at the dam, not the number collected; FGE's at these dams are not currently established. Also, there is no transportation from these dams.

**** Note: (See next page)

***** Note: (See next page)

Table 7. (Cont'd) Juvenile collection at each of eight mainstem collection facilities in 2005 under full transportation and transportation with spill scenarios.

**** Note: The percentage of listed wild and hatchery spring/summer and fall Chinook salmon at McNary, John Day, and The Dalles Dams are:

For example, If you handle 1,000 yearling Chinook salmon at Tongue Point, under the Full Transportation with spill scenario (above),

33.83% of them will be listed wild fish, or 338 fish. To these 338 fish, apply the percentages

listed below under the Tongue Point section to determine how many are from each ESU

(SR, $338 \times 0.3122 = 106$; UCR, $338 \times 0.0550 = 19$; etc).

Spring/Summer Chinook salmon	Full Transportation		Full Transportation with spill	
	Wild	Hatchery	Wild	Hatchery
SR	25.70	22.60	44.63	31.20
UCR	74.30	77.40	55.37	68.80
LCR - Spring	---	---	---	---
UWR	---	---	---	---
Fall Chinook salmon				
SR	100.00	---	100.00	---
LCR - Tule fall	---	---	---	---
LCR - Late run fall	---	---	---	---

***** Note: Because the Columbia River is a free flowing river below Bonneville Dam and there are no survival estimates available, survival was set at 100% to Tongue Point.

The percentage of listed wild and hatchery spring/summer and fall Chinook salmon at and downstream of Bonneville Dam are:

Bonneville Dam				
Spring/Summer Chinook salmon	Full Transportation		Full Transportation with spill	
	Wild	Hatchery	Wild	Hatchery
SR	25.70	22.60	44.63	31.20
UCR	74.30	77.40	55.37	68.80
LCR - Spring	0.00	---	0.00	---
UWR	---	---	---	---
Fall Chinook salmon				
SR	1.13	---	1.65	---
LCR - Tule fall	98.87	---	98.35	---
LCR - Late run fall	---	---	---	---

Tongue Point				
Spring/Summer Chinook salmon	Full Transportation		Full Transportation with spill	
	Wild	Hatchery	Wild	Hatchery
SR	32.91	66.20	31.22	66.30
UCR	5.84	33.80	5.50	33.70
LCR – Spring	14.12	---	14.59	---
UWR	47.14	---	48.70	---

Table 7. (Cont'd) Juvenile collection at each of eight mainstem collection facilities in 2005 under full transportation and transportation with spill scenarios.

Fall Chinook salmon

SR	3.88	---	3.81	---
LCR - Tule fall	65.49	---	65.54	---
LCR - Late run fall	30.63	---	30.65	---

SR = Snake River ESU

UCR = Upper Columbia River ESU

LCR - Spring = Lower Columbia River ESU - Spring Chinook

UWR = Upper Willamette River ESU

LCR - Tule fall = Lower Columbia River ESU - Tule fall Chinook salmon

LCR - Late run fall = Lower Columbia River ESU - Late-run bright fall Chinook salmon

Table 8. Juvenile spring/summer Chinook salmon collection at each of the mainstem collection facilities in 2005 under full transportation and transportation with spill scenarios. Percentage of listed fish by rearing type (wild or hatchery) at each facility.

****Use this table only if the reartype of all handled fish is known****

	Full Transportation Scenario		Transportation with Spill Scenario	
	Spring/Summer Chinook salmon Wild	Listed hatchery	Spring/Summer Chinook salmon Wild	Listed hatchery
Total fish collected at:*				
Lower Granite	1,688,287	4,066,174	1,176,173	2,832,768
Little Goose	679,473	1,610,652	685,362	1,637,990
Lower Monumental	198,055	559,524	278,209	722,607
Ice Harbor**	122,354	362,388	285,060	755,838
<u>Columbia River</u>				
Wells***	337,725	732,259	337,725	732,259
Rocky Reach***	393,728	970,233	393,728	970,233
Rock Island***	727,705	2,234,810	727,705	2,234,810
Wanapum***	654,935	2,011,329	654,935	2,011,329
Priest Rapids***	589,442	1,810,196	589,442	1,810,196
McNary****	1,611,473	2,333,040	867,226	1,346,487
John Day** ****	706,609	800,960	289,402	385,559
The Dalles** ****	620,045	893,402	940,257	1,404,264
Bonneville (I & II combined)** *****	558,041	2,024,062	412,538	1,210,871
---To the tailrace of Bonneville	1,395,103	5,060,155	2,115,579	6,209,595
---To Tongue Point*****	14,815,161	22,469,384	14,406,480	21,714,888
Total listed fish at:				
Lower Granite	1,688,284	455,237	1,176,171	317,149
Little Goose	679,472	185,961	685,361	186,152
Lower Monumental	198,055	157,580	278,209	146,318
Ice Harbor**	122,354	100,266	285,060	155,130
<u>Columbia River</u>				
Wells***	337,725	582,259	337,725	582,259
Rocky Reach***	393,728	524,033	393,728	524,033
Rock Island***	727,705	705,130	727,705	705,130
Wanapum***	654,935	634,617	654,935	634,617
Priest Rapids***	589,442	571,155	589,442	571,155
McNary****	571,223	531,551	367,906	286,745
John Day** ****	77,115	71,759	74,363	57,958
The Dalles** ****	46,269	43,055	191,219	149,035
Bonneville (I & II combined)** & *****	41,642	38,750	83,897	65,389

Table 8. (Cont'd) Juvenile spring/summer Chinook salmon collection at each of the mainstem collection facilities in 2005 under full transportation and transportation with spill scenarios. Percentage of listed fish by rearing type (wild or hatchery) at each facility.

****Use this table only if the reartype of all handled fish is known****

	Full Transportation Scenario		Transportation with Spill Scenario	
	Spring/Summer Chinook salmon Wild	Listed hatchery	Spring/Summer Chinook salmon Wild	Listed hatchery
---To the tailrace of Bonneville	104,105	96,875	430,241	335,328
---To Tongue Point*****	12,481,349	1,368,343	12,219,259	1,244,906
Percent listed fish at:				
Lower Granite	100.00%	11.20%	100.00%	11.20%
Little Goose	100.00%	11.55%	100.00%	11.37%
Lower Monumental	100.00%	28.16%	100.00%	20.25%
Ice Harbor**	100.00%	27.67%	100.00%	20.52%
<u>Columbia River</u>				
Wells***	100.00%	79.52%	100.00%	79.52%
Rocky Reach***	100.00%	54.01%	100.00%	54.01%
Rock Island***	100.00%	31.55%	100.00%	31.55%
Wanapum***	100.00%	31.55%	100.00%	31.55%
Priest Rapids***	100.00%	31.55%	100.00%	31.55%
McNary****	35.45%	22.78%	42.42%	21.30%
John Day** ****	10.91%	8.96%	25.70%	15.03%
The Dalles** ****	7.46%	4.82%	20.34%	10.61%
Bonneville (I & II combined)** & *****	7.46%	1.91%	20.34%	5.40%
---To the tailrace of Bonneville	7.46%	1.91%	20.34%	5.40%
---To Tongue Point*****	84.25%	6.09%	84.82%	5.73%

Note: "Total fish collected at:" is the total number of fish collected of that species or run, regardless of rearing type.

** Note: These dams have no transportation facilities, therefore, no fish are removed from the river at these dams.

*** Note: The numbers shown for these dams represent the number of fish arriving at the dam, not the number collected; FGE's at these dams are not currently established. Also, there is no transportation from these dams.

**** Note: (See next page)

***** Note: (See next page)

Table 8. (Cont'd) Juvenile spring/summer Chinook salmon collection at each of the mainstem collection facilities in 2005 under full transportation and transportation with spill scenarios. Percentage of listed fish by rearing type (wild or hatchery) at each facility.

****Use this table only if the reartype of all handled fish is known****

****Note: The percentage of listed wild and hatchery spring/summer and fall Chinook salmon at McNary, John Day, and The Dalles Dams are:

For example, If you handle 1,000 yearling Chinook salmon at Tongue Point, under the Full Transportation with spill scenario (above),

33.83% of them will be listed wild fish, or 338 fish. To these 338 fish, apply the percentages

listed below under the Tongue Point section to determine how many are from each ESU

(SR, $338 \times 0.3122 = 106$; UCR, $338 \times 0.0550 = 19$; etc).

Spring/Summer Chinook salmon	Full Transportation		Full Transportation with spill	
	Wild	Hatchery	Wild	Hatchery
SR	25.70	22.60	44.63	31.20
UCR	74.30	77.40	55.37	68.80
LCR - Spring	---	---	---	---
UWR	---	---	---	---

Fall

Chinook salmon

SR	100.00	---	100.00	---
LCR - Tule fall	---	---	---	---
LCR - Late run fall	---	---	---	---

Table 8. Juvenile spring/summer Chinook salmon collection at each of the mainstem collection facilities in 2005 under full transportation and transportation with spill scenarios. Percentage of listed fish by rearing type (wild or hatchery) at each facility.

***** Note: Because the Columbia River is a free flowing river below Bonneville Dam and there are no survival estimates available, survival was set at 100% to Tongue Point.

The percentage of listed wild and hatchery spring/summer and fall Chinook salmon at and downstream of Bonneville Dam are:

Bonneville Dam Spring/Summer Chinook salmon	Full Transportation		Full Transportation with spill	
	Wild	Hatchery	Wild	Hatchery
SR	25.70	22.60	44.63	31.20
UCR	74.30	77.40	55.37	68.80
LCR - Spring	0.00	---	0.00	---
UWR	---	---	---	---

Fall Chinook salmon

SR	1.13	---	1.65	---
LCR - Tule fall	98.87	---	98.35	---
LCR - Late run fall	---	---	---	---

Table 8. (Cont'd) Juvenile spring/summer Chinook salmon collection at each of the mainstem collection facilities in 2005 under full transportation and transportation with spill scenarios. Percentage of listed fish by rearing type (wild or hatchery) at each facility.

****Use this table only if the reartype of all handled fish is known****

Tongue Point					
Spring/Summer		Full Transportation		Full Transportation with spill	
Chinook salmon		Wild	Hatchery	Wild	Hatchery
SR		32.91	66.20	31.22	66.30
UCR		5.84	33.80	5.50	33.70
LCR - Spring		14.12	---	14.59	---
UWR		47.14	---	48.70	---
Fall Chinook salmon					
SR		3.88	---	3.81	---
LCR - Tule fall		65.49	---	65.54	---
LCR - Late run fall		30.63	---	30.65	---

SR = Snake River ESU

UCR = Upper Columbia River ESU

LCR - Spring = Lower Columbia River ESU - Spring Chinook

UWR = Upper Willamette River ESU

LCR - Tule fall = Lower Columbia River ESU - Tule fall Chinook salmon

LCR - Late run fall = Lower Columbia River ESU - Late-run bright fall Chinook salmon

Table 9. Juvenile steelhead trout collection at each of the mainstem collection facilities in 2005 under full transportation and transportation with spill scenarios.

	Full Transportation Scenario		Transportation with Spill Scenario	
	Wild steelhead trout	Listed hatchery steelhead trout	Wild steelhead trout	Listed hatchery steelhead trout
Total fish collected at:*				
<u>Snake River</u>				
Lower Granite	6,425,413	6,425,413	3,766,898	3,766,898
Little Goose	1,321,232	1,321,232	1,995,059	1,995,059
Lower Monumental	269,294	269,294	902,718	902,718
Ice Harbor**	116,683	116,683	711,731	711,731
<u>Columbia River</u>				
Wells***	598,142	598,142	598,142	598,142
Rocky Reach***	687,645	687,645	687,645	687,645
Rock Island***	946,619	946,619	946,619	946,619
Wanapum***	851,957	851,957	851,957	851,957
Priest Rapids***	766,761	766,761	766,761	766,761
McNary****	1,159,400	1,159,400	392,309	392,309
John Day** ****	349,338	349,338	481,673	481,673
The Dalles** ****	337,154	337,154	936,735	936,735
Bonneville (I & II combined)** *****	463,270	463,270	445,801	445,801
---To the tailrace of Bonneville	842,309	842,309	1,921,556	1,921,556
---To Tongue Point****	13,692,298	13,692,298	12,704,332	12,704,332
Total listed fish at:				
<u>Snake River</u>				
Lower Granite	866,327	0	507,884	0
Little Goose	178,581	0	269,139	0
Lower Monumental	30,161	0	117,632	0
Ice Harbor**	12,910	0	92,383	0
<u>Columbia River</u>				
Wells***	111,730	486,482	111,730	486,482
Rocky Reach***	133,327	544,668	133,327	544,668
Rock Island***	152,875	785,059	152,875	785,059
Wanapum***	137,588	706,553	137,588	706,553
Priest Rapids***	123,829	635,898	123,829	635,898
McNary****	195,577	615,334	61,285	134,006
John Day** ****	173,370	43,073	119,499	130,114
The Dalles** ****	144,032	27,690	237,046	222,629

Table 9. (Cont'd) Juvenile steelhead trout collection at each of the mainstem collection facilities in 2005 under full transportation and transportation with spill scenarios.

Total fish collected at:*	Full Transportation Scenario		Transportation with Spill Scenario	
	Wild Steelhead Trout	Listed Hatchery Steelhead Trout	Wild Steelhead Trout	Listed Hatchery Steelhead Trout
Bonneville (I & II combined)** *****	177,589	27,413	113,753	92,970
---To the tailrace of Bonneville	322,889	49,842	490,315	400,733
---To Tongue Point****	2,018,331	665,176	1,876,792	534,739
Percent listed fish at:				
<u>Snake River</u>				
Lower Granite	13%	0.00%	13.48%	0.00%
Little Goose	14%	0.00%	13.49%	0.00%
Lower Monumental	11%	0.00%	13.03%	0.00%
Ice Harbor**	11%	0.00%	12.98%	0.00%
<u>Columbia River</u>				
Wells***	19%	81.33%	18.68%	81.33%
Rocky Reach***	19%	79.21%	19.39%	79.21%
Rock Island***	16%	82.93%	16.15%	82.93%
Wanapum***	16%	82.93%	16.15%	82.93%
Priest Rapids***	16%	82.93%	16.15%	82.93%
McNary****	17%	53.07%	15.62%	34.16%
John Day** *****	50%	12.33%	24.81%	27.01%
The Dalles** *****	43%	8.21%	25.31%	23.77%
Bonneville (I & II combined)** *****	38%	5.92%	25.52%	20.86%
---To the tailrace of Bonneville	38%	5.92%	25.52%	20.86%
---To Tongue Point****	15%	4.86%	14.77%	4.21%

* Note: "Total fish collected at:" is the total number of fish collected of that species or run, regardless of rearing type.

** Note: These dams have no transportation facilities, therefore, no fish are removed from the river at these dams.

*** Note: The numbers shown for these dams represent the number of fish arriving at the dam, not the number collected; FGE's at these dams are not currently established at this time. Also, there is no transportation from these dams.

**** Note: (See next page)

Table 9. (Cont'd) Juvenile steelhead trout collection at each of the mainstem collection facilities in 2005 under full transportation and transportation with spill scenarios.

**** Note: The percentage of listed wild and hatchery fish from each ESU at each Columbia River dam from McNary Dam to Bonneville Dam and at Tongue Point.

For example, If you handle 1,000 steelhead at Tongue Point, under the Full Transportation with spill scenario (above),

14.77% of them will be listed wild fish, or 148 fish. To these 148 fish, apply the percentages listed below under the Tongue Point section to determine how many are from each ESU (SR, $148 \times 0.5283 = 78$; UCR, $148 \times 0.0439 = 6$; etc).

	Full Transportation		Full Transportation with spill	
	Wild	Hatchery	Wild	Hatchery
McNary Dam				
SR	7.13	2.43	35.46	3.66
UCR	51.29	97.57	35.64	96.34
MCR - Summer	41.59	---	28.90	---
MCR - Winter	---	---	---	---
LCR	---	---	---	---
UWR	---	---	---	---
John Day Dam				
SR	0.62	2.43	18.59	3.66
UCR	4.46	97.57	18.69	96.34
MCR - Summer	94.92	---	62.73	---
MCR - Winter	---	---	---	---
LCR	---	---	---	---
UWR	---	---	---	---
The Dalles Dam				
SR	0.48	2.43	16.15	3.66
UCR	3.46	97.57	16.24	96.34
MCR - Summer	96.06	---	67.62	---
MCR - Winter	---	---	---	---
LCR	---	---	---	---
UWR	---	---	---	---
Bonneville Dam				
SR	0.38	2.43	13.94	3.66
UCR	2.72	97.57	14.02	96.34
MCR - Summer	75.59	---	58.38	---
MCR - Winter	5.55	---	3.55	---
LCR	15.77	---	10.10	---
UWR	---	---	---	---

Table 9. (Cont'd) Juvenile steelhead trout collection at each of the mainstem collection facilities in 2005 under full transportation and transportation with spill scenarios.

Tongue Point	Full Transportation		Full Transportation with spill	
	Wild	Hatchery	Wild	Hatchery
SR	54.38	7.71	52.83	8.28
UCR	5.36	92.29	4.69	91.72
MCR - Summer	15.33	---	15.63	---
MCR - Winter	0.83	---	0.89	---
LCR	13.23	---	14.24	---
UWR	10.87	---	11.70	---

SR = Snake River ESU

UCR = Upper Columbia River ESU

MCR - Summer = Mid Columbia River ESU summer steelhead

MCR - Winter = Mid Columbia River ESU winter steelhead

LCR = Lower Columbia River ESU

UWR = Upper Willamette River ESU

Table 10. Juvenile steelhead trout collection at each of the mainstem collection facilities in 2005 under full transportation and transportation with spill scenarios. Percentage of listed fish by rearing type (wild or hatchery) at each facility.

****Use this table only if the reartype of all handled fish is known****

Total fish collected at:*	Full Transportation Scenario		Transportation with Spill Scenario	
	Wild steelhead trout	Listed hatchery steelhead trout	Wild steelhead trout	Listed hatchery steelhead trout
<u>Snake River</u>				
Lower Granite	866,327	5,559,086	507,884	3,259,014
Little Goose	178,581	1,142,651	269,139	1,725,920
Lower Monumental	30,161	239,133	117,632	785,085
Ice Harbor**	12,910	103,773	92,383	619,347
<u>Columbia River</u>				
Wells***	111,730	486,482	111,730	486,482
Rocky Reach***	133,327	554,318	133,327	554,318
Rock Island***	152,875	793,744	152,875	793,744
Wanapum***	137,588	714,370	137,588	714,370
Priest Rapids***	123,829	642,933	123,829	642,933
McNary****	195,577	963,823	61,284	331,024
John Day** ****	173,370	175,968	119,498	362,174
The Dalles** ****	144,032	193,122	237,044	699,689
Bonneville (I & II combined)** *****	177,589	285,681	113,752	332,048
---To the tailrace of Bonneville	322,889	519,420	490,310	1,431,241
---To Tongue Point*****	2,086,803	11,629,628	1,945,258	10,763,243
Total listed fish at:				
<u>Snake River</u>				
Lower Granite	866,327	0	507,884	0
Little Goose	178,581	0	269,139	0
Lower Monumental	30,161	0	117,632	0
Ice Harbor**	12,910	0	92,383	0
<u>Columbia River</u>				
Wells***	111,730	486,482	111,730	486,482
Rocky Reach***	133,327	544,668	133,327	544,668
Rock Island***	152,875	785,059	152,875	785,059
Wanapum***	137,588	706,553	137,588	706,553
Priest Rapids***	123,829	635,898	123,829	635,898
McNary****	195,577	615,334	61,285	134,006

Table 10. (Cont'd) Juvenile steelhead trout collection at each of the mainstem collection facilities in 2005 under full transportation and transportation with spill scenarios. Percentage of listed fish by rearing type (wild or hatchery) at each facility.

****Use this table only if the reartype of all handled fish is known****

	Full Transportation Scenario		Transportation with Spill Scenario	
	Wild steelhead trout	Listed hatchery steelhead trout	Wild steelhead trout	Listed hatchery steelhead trout
Total fish collected at:*				
John Day** ****	173,370	43,073	119,499	130,114
The Dalles** ****	144,032	27,690	237,046	222,629
Bonneville (I & II combined)** *****	177,589	27,413	113,753	92,970
---To the tailrace of Bonneville	322,889	49,842	490,315	400,733
---To Tongue Point*****	2,018,331	665,176	1,876,792	534,739
Percent listed fish at:				
<u>Snake River</u>				
Lower Granite	100.00%	0.00%	100.00%	0.00%
Little Goose	100.00%	0.00%	100.00%	0.00%
Lower Monumental	100.00%	0.00%	100.00%	0.00%
Ice Harbor**	100.00%	0.00%	100.00%	0.00%
<u>Columbia River</u>				
Wells***	100.00%	100.00%	100.00%	100.00%
Rocky Reach***	100.00%	98.26%	100.00%	98.26%
Rock Island***	100.00%	98.91%	100.00%	98.91%
Wanapum***	100.00%	98.91%	100.00%	98.91%
Priest Rapids***	100.00%	98.91%	100.00%	98.91%
McNary****	100.00%	63.84%	100.00%	40.48%
John Day** ****	100.00%	24.48%	100.00%	35.93%
The Dalles** ****	100.00%	14.34%	100.00%	31.82%
Bonneville (I & II combined)** *****	100.00%	9.60%	100.00%	28.00%
---To the tailrace of Bonneville	100.00%	9.60%	100.00%	28.00%
---To Tongue Point****	96.72%	5.72%	96.48%	4.97%

* Note: "Total fish collected at:" is the total number of fish collected of that species, run and rearing type.

** Note: These dams have no transportation facilities, therefore, no fish are removed from the river at these dams.

*** Note: The numbers shown for these dams represent the number of fish arriving at the dam, not the number collected; FGE's at these dams are not currently established. Also, there is no transportation from these dams.

**** Note: (See next page)

Table 10. (Cont'd) Juvenile steelhead trout collection at each of the mainstem collection facilities in 2005 under full transportation and transportation with spill scenarios. Percentage of listed fish by rearing type (wild or hatchery) at each facility.

**** Note: The percentage of listed wild fish from each ESU at each Columbia River dam from McNary Dam to Bonneville Dam and at Tongue Point. All listed hatchery fish are from the Upper Columbia River ESU.

For example, If you handle 1,000 steelhead at Tongue Point, under the Full Transportation with spill scenario (above),

96.48% of them will be listed wild fish, or 965 fish. To these 965 fish, apply the percentages

listed below under the Tongue Point section to determine how many are from each ESU

(SR, $965 \times 0.5283 = 510$; UCR, $965 \times 0.0469 = 45$; etc).

	Full Transportation		Full Transportation with spill	
McNary Dam	Wild	Hatchery	Wild	Hatchery
SR	7.13	2.43	35.46	3.66
UCR	51.29	97.57	35.64	96.34
MCR - Summer	41.59	---	28.90	---
MCR - Winter	---	---	---	---
LCR	---	---	---	---
UWR	---	---	---	---
John Day Dam				
SR	0.62	2.43	18.59	3.66
UCR	4.46	97.57	18.69	96.34
MCR - Summer	94.92	---	62.73	---
MCR - Winter	---	---	---	---
LCR	---	---	---	---
UWR	---	---	---	---
The Dalles Dam				
SR	0.48	2.43	16.15	3.66
UCR	3.46	97.57	16.24	96.34
MCR - Summer	96.06	---	67.62	---
MCR - Winter	0.00	---	0.00	---
LCR	---	---	---	---
UWR	---	---	---	---
Bonneville Dam				
SR	0.38	2.43	13.94	3.66
UCR	2.72	97.57	14.02	96.34
MCR - Summer	75.59	---	58.38	---
MCR - Winter	5.55	---	3.55	---
LCR	15.77	---	10.10	---
UWR	---	---	---	---

Table 10. (Cont'd) Juvenile steelhead trout collection at each of the mainstem collection facilities in 2005 under full transportation and transportation with spill scenarios. Percentage of listed fish by rearing type (wild or hatchery) at each facility.

**** Note: The percentage of listed wild fish from each ESU at each Columbia River dam from McNary Dam to Bonneville Dam and at Tongue Point. All listed hatchery fish are from the Upper Columbia River ESU.

For example, If you handle 1,000 steelhead at Tongue Point, under the Full Transportation with spill scenario (above),

96.48% of them will be listed wild fish, or 965 fish. To these 965 fish, apply the percentages

listed below under the Tongue Point section to determine how many are from each ESU

(SR, $965 \times 0.5283 = 510$; UCR, $965 \times 0.0469 = 45$; etc).

Tongue Point

SR	54.38	7.71	52.83	8.28
UCR	5.36	92.29	4.69	91.72
MCR - Summer	15.33	---	15.63	---
MCR - Winter	0.83	---	0.89	---
LCR	13.23	---	14.24	---
UWR	10.87	---	11.70	---

SR = Snake River ESU

UCR = Upper Columbia River ESU

MCR - Summer = Mid Columbia River ESU summer steelhead

MCR - Winter = Mid Columbia River ESU winter steelhead

LCR = Lower Columbia River ESU

UWR = Upper Willamette River ESU

Table 11. Estimated number of listed fish outmigrating from each ESU, 2005.

ESU	Species	Run	<u>Number of listed fish</u>	
			Wild	Hatchery ^a
Snake River	Chinook	Spring/summer	2,813,811	1,453,900
		Fall	595,392	
	Steelhead	Summer	1,107,909	0
	Sockeye		5,567	21,517
Upper Columbia	Chinook	Spring	800,850	981,905
	Steelhead	Summer	177,381	990,000
Mid-Columbia	Steelhead	Summer	383,644	
		Winter	16,557	
Lower Columbia	Chinook	Spring	1,152,358	
		Fall (tule)	8,572,269	
		Fall (late run)	4,009,111	
		Summer/Winter	263,832	
Steelhead				
Upper Willamette	Chinook	Spring	3,847,700	
	Steelhead	Winter	216,784	
Columbia River	Chum	No estimate		

^a Listed hatchery numbers are release numbers.

Appendix A.

Determination of the effects of returning all PIT-tagged spring/summer Chinook salmon to the river at each collection dam on the number of fish that arrive at each subsequent dam

We surveyed researchers regarding the number of outmigrating PIT-tagged spring/summer Chinook salmon in the Snake River we could expect in 2005. We found that 227,000 hatchery fish will be PIT tagged and released above Lower Granite Dam as part of the Comparative Survival Study (CSS). We applied the hatchery survival estimates found in Table 1 to the fish released from hatcheries to determine the number of CSS hatchery fish that will arrive at Lower Granite Dam (145,489). The CSS requires that 70% of the fish collected at each of the Snake River collector dams be transported.

Another 27,139 hatchery spring/summer Chinook salmon (PIT tagged at hatcheries (not part of the CSS) and traps) will arrive at Lower Granite Dam. Of the 172,628 (145,489 + 27,139) hatchery fish reaching Lower Granite Dam, 42,643 will be listed hatchery fish.

Because tagging for the 2005 outmigration year began in July 2004 and continues throughout the outmigration year, we cannot accurately estimate survival from tagging of natural and inriver fish to the head of the Lower Granite Reservoir. We assumed that all of these fish would survive to the head of the reservoir, realizing that this is an overestimation. We chose the head of the reservoir because that is where the last of the tagging occurs, and because we have survival estimates from the head of the reservoir to the tailrace of Lower Granite Dam. It is expected that 66,606 wild spring/summer Chinook salmon will be PIT tagged above Lower Granite Dam. Using 90% survival from tagging location through the Lower Granite Dam pool, 59,945 ($66,606 \times 0.90$) will arrive at Lower Granite Dam.

National Marine Fisheries Service will be PIT-tagging fish at Lower Granite Dam during the 2005 outmigration. As part of this marking, 10,000 PIT-tagged wild and 239,598 PIT-tagged hatchery spring/summer Chinook salmon will be released into the Lower Granite Dam tailrace. As these fish move downstream, all of those collected at Little Goose and Lower Monumental Dams will be diverted back to the river.

Approximately 4,400 fish (400 wild and 4,000 hatchery) will be released in the Tucannon River. These fish are assumed to arrive at Lower Monumental Dam with no mortality.

We performed two calculations to determine the expected number of PIT-tagged fish collected at each collector dam. The first calculation made use of the same formulas used under the "Transportation with Spill" and "Full Transportation" scenarios which assume that every fish collected is transported (except the CSS fish). This calculation provided the number of fish collected at each dam if no PIT-tagged fish were returned to the river. In other words, this calculation is based solely on the number of fish that are not collected and transported at upstream dam(s).

In the second calculation we assumed that the only fish transported at each Snake River collector dam are the CSS fish. This calculation provided the number of fish collected at each dam if the remaining PIT-tagged fish were returned to the river. This calculation includes both the fish that were returned to the river at upstream dam(s) and the fish that were not collected at upstream dam(s). Because the number derived from the second calculation includes the number from the first calculation, the difference between the numbers from these two calculations is the number of PIT-tagged fish that were collected at each dam that were not accounted for because they were returned to the river at each dam (the number for each dam was added to the appropriate "... fish collected ..." columns in Tables 7-8). This difference in the number of fish collected was then expanded to the number of fish that arrived at the dam by dividing by the FGE of that dam, and was added to the number of fish that arrived at McNary Dam because they had not been collected and transported at upstream dams under both the "Transportation with Spill" and "Full Transportation" scenarios (column "Listed fish to McNary" in Tables 2 and 3, respectively).

Calculation 1 (Transportation)

Transportation with Spill Scenario--The numbers presented below assume that 58.2% of the PIT-tagged fish arriving at Lower Granite Dam will not be collected (FGE = 41.8%), and that 30% of the CSS fish are returned to the river. In addition, 10,000 wild and 239,598 hatchery fish will be released into the tailrace of Lower Granite Dam from marking at the dam.

Using the FGEs in Table 2, the estimated number of PIT-tagged fish collected at each dam below Lower Granite Dam in 2005 will be

Dam	Wild	Listed hatchery	Unlisted hatchery	Total
Little Goose	18,503	29,158	106,896	154,557
Lower Monumental	7,118	12,410	40,303	59,831
McNary	4,040	7,044	22,876	33,960

Full Transportation Scenario--The numbers presented below assume that 40.0% of the PIT-tagged fish arriving at Lower Granite Dam will not be collected (FGE = 60.0%), and that 30% of the CSS fish are returned to the river. In addition, 10,000 wild and 239,598 hatchery fish will be released into the tailrace of Lower Granite Dam from marking at the dam.

Using the FGEs in Table 3, the estimated number of PIT-tagged fish collected at each dam below Lower Granite Dam in 2005 will be

Dam	Wild	Listed hatchery	Unlisted hatchery	Total
Little Goose	19,877	36,842	137,868	194,587
Lower Monumental	5,016	10,927	33,406	49,349
McNary	3,251	7,081	21,647	31,979

Calculation 2 (Only CSS fish transported)

This calculation assumes that all collected PIT-tagged fish (except the CSS fish) are returned to the river at each Snake River collector dam.

For the PIT-tagged fish returned to the river at each collection dam, the only loss of fish as they migrate downstream is the mortality through each reservoir and dam. Based on the NMFS survival studies, survival through each reservoir and dam was estimated to be 90%. The estimated number of PIT-tagged fish collected at each dam below Lower Granite Dam in 2005 will be

Transportation with Spill Scenario

Dam	Wild	Listed hatchery	Unlisted hatchery	Total
Little Goose	28,831	33,290	114,959	177,080
Lower Monumental	20,197	22,840	72,241	115,278
McNary	17,746	19,268	59,908	96,922

Full Transportation Scenario

Dam	Wild	Listed hatchery	Unlisted hatchery	Total
Little Goose	40,918	45,261	154,293	240,472
Lower Monumental	28,528	30,487	94,117	153,132
McNary	36,972	37,963	115,074	190,009

Subtracting collection numbers estimated by Calculation 1 from Calculation 2 provides the number of unaccounted for PIT-tagged fish that were collected at each dam (Appendix Table A1).

Appendix Table A1. Estimates of the number of unaccounted for PIT-tagged spring/summer Chinook salmon that will be collected at each of the collection dams, and estimates of how many of these fish will arrive at McNary Dam, 2005.

Transportation with Spill Scenario

Dam	Wild	Listed hatchery	Unlisted hatchery	Total
Number of unaccounted for PIT-tagged fish collected:				
Little Goose	10,328	4,132	8,063	22,523
Lower Monumental	13,079	10,430	31,938	55,447
McNary	13,706	12,224	37,032	62,962
Number of unaccounted for PIT-tagged fish that arrived at McNary Dam (FGE = 0.384):				
McNary	35,693	31,833	96,438	163,964

Full Transportation Scenario (No Spill)

Dam	Wild	Listed hatchery	Unlisted hatchery	Total
Number of unaccounted for PIT-tagged fish collected:				
Little Goose	21,041	8,419	16,425	45,885
Lower Monumental	23,512	19,560	60,711	103,783
McNary	33,721	30,882	93,427	158,030
Number of unaccounted for PIT-tagged fish that arrived at McNary Dam (FGE = 0.80):				
McNary	42,151	38,603	116,784	197,538

Appendix B.

Determination of the effects of returning all PIT-tagged steelhead to the river at each collection dam on the number of fish that arrive at each subsequent dam

We surveyed researchers regarding the number of outmigrating PIT-tagged steelhead in the Snake River we could expect in 2005. We found that 17,050 hatchery fish will be PIT tagged prior to release above Lower Granite Dam. Based on the survival rates of the various hatcheries releasing fish, we estimate that 13,401 will arrive at Lower Granite Dam. Another 12,735 hatchery steelhead (PIT tagged at traps) will arrive at Lower Granite Dam, bringing the total to 26,136 hatchery fish arriving at Lower Granite Dam. In addition, 4,860 wild steelhead PIT tagged at traps will arrive at Lower Granite Dam.

National Marine Fisheries Service will be PIT-tagging steelhead at Lower Granite Dam during the 2005 outmigration. As part of this marking, 30,000 PIT-tagged fish will be released into the Lower Granite Dam tailrace. Of these, approximately 10,000 will be wild fish and 20,000 will be hatchery fish. All of the fish collected at Little Goose and Lower Monumental Dams will be diverted back to the river.

We performed two calculations to determine the expected number of PIT-tagged fish collected at each collector dam. The first calculation made use of the same formulas used under the "Transportation with Spill" and "Full Transportation" scenarios which assume that every fish collected is transported. This calculation provided the number of fish collected at each dam if no PIT-tagged fish were returned to the river. In other words, this calculation is based solely on the number of fish that are not collected and transported at upstream dam(s).

In the second calculation we assumed that no fish are transported. This calculation provided the number of fish collected at each dam if all PIT-tagged fish were returned to the river. This calculation includes both the fish that were returned to the river at upstream dam(s) and the fish that were not collected at upstream dam(s). Because the number derived from the second calculation includes the number from the first calculation, the difference between the numbers from these two calculations is the number of PIT-tagged fish that were collected at each dam that were not accounted for because they were returned to the river at each dam (the number for each dam was added to the appropriate "... fish collected ..." columns in Tables 9-10). This difference in the number of fish collected was then expanded to the number of fish that arrived at the dam by dividing by the FGE of that dam, and was added to the number of fish that arrived at McNary Dam because they had not been collected and transported at upstream dams under both the "Transportation with Spill" and "Full Transportation" scenarios (column "Listed fish to McNary" in Tables 5 and 6, respectively).

Calculation 1 (Transportation)

Transportation with Spill Scenario--Assuming that 53.1% of the PIT-tagged fish arriving at Lower Granite Dam will not be collected (FGE = 46.9%), 2,581 ($4,860 \times 0.531$) wild and 13,878 ($26,136 \times 0.531$) unlisted hatchery fish will reach the Lower Granite Dam tailrace. In addition, 10,000 wild and 20,000 unlisted hatchery fish will be released into the tailrace from marking at the dam. Therefore, the total numbers of PIT-tagged fish in the Lower Granite Dam tailrace will be 12,581 ($2,581 + 10,000$) wild and 33,878 ($13,878 + 20,000$) unlisted hatchery fish.

Using the FGEs in Table 5, the estimated number of PIT-tagged fish collected at each dam below Lower Granite Dam in 2005 will be

Dam	Wild	Unlisted hatchery	Total
Little Goose	5,865	15,794	21,659
Lower Monumental	2,522	6,653	9,175
McNary	459	1,348	1,807

Full Transportation Scenario--Assuming that 20.0% of the PIT-tagged fish arriving at Lower Granite Dam will not be collected (FGE = 80.0%), 972 ($4,860 \times 0.20$) wild and 5,227 ($26,136 \times 0.20$) unlisted hatchery fish will reach the Lower Granite Dam tailrace. In addition, 10,000 wild and 20,000 unlisted hatchery fish will be released into the tailrace from marking at the dam. Therefore, the total numbers of PIT-tagged fish in the Lower Granite Dam tailrace will be 10,972 ($972 + 10,000$) wild and 25,227 ($5,227 + 20,000$) unlisted hatchery fish.

Using the FGEs in Table 6, the estimated number of PIT-tagged fish collected at each dam below Lower Granite Dam in 2005 will be

Dam	Wild	Unlisted hatchery	Total
Little Goose	8,887	20,434	29,321
Lower Monumental	903	2,011	2,914
McNary	354	1,419	1,773

Calculation 2 (No Transportation)

Assuming that 100% of the collected PIT-tagged fish are returned to the river at Lower Granite Dam, 14,860 ($4,860 + 10,000$) wild and 46,136 ($26,136 + 20,000$) unlisted hatchery fish will reach the tailrace.

Because 100% of the PIT-tagged fish were assumed to be returned to the river at each collection dam, the only loss of fish as they migrate downstream is the mortality through each reservoir and dam. Based on the NMFS survival studies, survival through each reservoir and dam was estimated to be 90%. The estimated number of PIT-tagged fish collected at each dam below Lower Granite Dam in 2005 will be

Transportation with Spill Scenario

Dam	Wild	Unlisted hatchery	Total
Little Goose	6,928	21,509	28,437
Lower Monumental	3,887	17,904	21,791
McNary	1,035	6,100	7,135

Full Transportation Scenario

Dam	Wild	Unlisted hatchery	Total
Little Goose	12,037	37,370	49,407
Lower Monumental	3,411	24,973	28,384
McNary	3,442	28,639	32,081

Subtracting collection numbers estimated by Calculation 1 from Calculation 2 provides the number of unaccounted for PIT-tagged fish that were collected at each dam (Appendix Table B1).

Appendix Table B1. Estimates of the number of unaccounted for PIT-tagged steelhead that will be collected at each of the collection dams, and estimates of how many of these fish will arrive at McNary Dam, 2005.

Transportation with Spill Scenario

Dam	Wild	Unlisted hatchery	Total
Number of unaccounted for PIT-tagged fish collected:			
Little Goose	1,063	5,715	6,778
Lower Monumental	1,365	11,251	12,616
McNary	576	4,752	5,328
Number of unaccounted for PIT-tagged fish that arrived at McNary Dam (FGE = 0.196):			
McNary	2,941	24,243	27,184

Full Transportation Scenario (No Spill)

Dam	Wild	Unlisted hatchery	Total
Number of unaccounted for PIT-tagged fish collected:			
Little Goose	3,150	16,936	20,086
Lower Monumental	2,508	22,962	25,470
McNary	3,088	27,220	30,308
Number of unaccounted for PIT-tagged fish that arrived at McNary Dam (FGE = 0.90):			
McNary	3,431	30,244	33,675